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AIDS TO DENTAL SURGERY

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TO

DENTAL SURGERY

BY,
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THIRD



EDITION

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PREFACE TO THIRD EDITION

THIS little book has again been brought up to date, and though its small size is a greater difficulty than ever, yet it is hoped that it may still "aid" students in revising their work.

Since the last edition we have to record with deep regret the loss of Mr. Arthur Underwood, but a sincere effort has been made to retain the spirit in which he designed this work.

DOUGLAS GABELL.

9, PORTLAND PLACE,
December, 1920.

PREFACE

TO FIRST EDITION

IN the following pages I have endeavoured to condense into a concise form that department of the science of dental surgery which is capable of such treatment. I have thought it best to entirely omit that portion which is purely manipulative, and must be learnt at the operating-chair, and there alone. In large books of reference such matters may be treated with advantage; in small hand-books they are out of place. It has been my object to treat most fully those matters the discussion of which comes obviously within the range of the theoretical portion of examinations. If the book smooths the path of any of the large body of dental students, with whose education and welfare my daily work has been and is so largely concerned, I shall feel that its object has been accomplished. I propose to publish a similar volume, treating the subject of dental anatomy on similar lines, during the ensuing year.

ARTHUR S. UNDERWOOD.

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AIDS TO DENTAL SURGERY

INTRODUCTION.

As an aid to memory, a regular order has been followed in dealing with the diseases of each tissue, as follows

Congenital Malformation.

Atrophy and Hypertrophy

New Growths.

(a) Innocent.

(b) Malignant

Inflammations

Definition.

Ætiology

(a) Actual :

1. Traumatic.

2. Infective.

(b) Predisposing :

1. Local.

2. General.

Pathological Anatomy and Course :

Changes in Vessels and Tissues during Attack, and Termination in Resolution, Organization, Suppuration, or Necrosis.

Symptoms :

(a) Local, describing the (1) Pain, (2) Heat, (3) Redness, (4) Swelling (and Discharge), (5) Impairment of Function, (6) nearest Lymphatic Glands.

(b) General, describing the Fever or Toxæmia or Shock

Diagnosis :

- (a) From Similar Diseases.
- (b) As to Causes.
- (c) .. Position and Extent.
- (d) .. Severity and Prognosis.

Treatment :

- (a) Preventive.
- (b) Curative.
 - 1. Local.
 - 2. General.

Injuries are dealt with separately.

This order is arbitrary, but any regular order for arranging the mass of facts to be remembered will be of great use to students.

Also before treating any disease or injury on the mouth or teeth try to ascertain **all** the facts of the case by a systematic examination :

- 1. By inspection ;
- 2. By palpation ;
- 3. By asking questions.

1. Inspection.—Start by having a look at the patient, to note age ; signs of general illness, such as flushed face (high temperature), dull-coloured skin and wearied look (chronic poisoning) ; general activity of movements, clearness of eye ; signs of chronic alcoholism, etc.

Secondly, look at the face and neck for any **swelling** ; compare each side in an even light (swelling may be shown only by the filling out of hollows) ; note the extent, shape, and position of the swelling ; note the **colour** : redness indicates acute superficial inflammation, duskiness chronic inflammation, mottled deeper inflammation. Look for **scars**, large veins, extra growth of hair.

Look inside the mouth. Note first the general appearance of the teeth. Brilliant, polished teeth usually mean a healthy mouth ; clean-looking but dull teeth almost

always mean inflammation between the teeth; dirty teeth will have inflamed gums. If in doubt, paint liquor iodi fortis over the teeth, let it dry on, and then get the patient to rinse the mouth; clean teeth will at once appear quite white, but any dirt and germ mycelium will be stained black. Look at the tongue and throat. A furred tongue will contaminate the teeth and gums; enlarged tonsils or deep-red throat mean septic conditions. Again note the size, position, shape, colour, of any swellings and scars. Remember that bubbles of saliva can hide many marks, so dry any portion of tongue or gum that you wish to see well.

Lastly, with mirror, lamp, and wool swabs examine minutely each tooth all over, and the gums and alveoli.

If necessary obtain skiagrams from two different angles.

2. **Palpation.** On any external swelling lay as large a part of the fingers and palm of the hand as possible, then quickly transfer the same hand to the other side of the patient's face, and feel if the **heat** is the same; increased heat indicates inflammation. Then gently feel all over the swelling with the soft pulps of the fingers and determine the **size, shape, and hardness** of each part. Note any **tenderness** and its exact situation. If the swelling is soft or resilient try for **fluctuation** by first resting the part against a firm support; secondly, placing as many fingers as possible as far apart as possible on the swelling, and gently pressing with one whilst feeling with the other, alternately; thirdly, repeat in a line at right angles to the first attempt; fourthly, test each part of the swelling. Try to pinch up the skin over the swelling to see if it is involved, or if the swelling is only below it. Place the patient so that the muscles, skin, ligaments, etc., are relaxed about the swelling, and then try to move it to see

to what parts it is attached, and how much. Notice any **pulsation** in or attached to the swelling.

Similarly, examine any swelling inside the mouth. Heat is very difficult to detect, and also the feeling of fluctuation is often felt in swellings on the palate when no free fluid is present; also, it is not possible to steady the tongue for examination. Palpate the gums firmly, slowly, and all over; where teeth are present the outline of their roots are normally detectable; tender spots should be accurately located and defined: a hard rounded swelling suggests a **fluid** tumour within the bone, nodular swellings solid growths. Test the firmness of the teeth, and any tenderness to pressure in each or any one direction. Notice any sudden limits to movements.

With small sharp **probe** examine each fissure and all surfaces of each tooth.

3. **Questions.**— Allow the patient to describe his symptoms (**signs** are what you see or feel, **symptoms** are what the patient feels) and the course of events. Do not suggest things to him, but try to get accurate times for each event and accurate details. Be sure you understand what the patient **means** by the expressions he uses; patients are very apt to use technical terms of which they do not know the true meaning; also to use picturesque terms that are very enlightening if you take the trouble to find out their meaning. Most patients exaggerate and are very inaccurate, but sympathetic cross-examination should enable you to get much nearer the truth. Patients never confine themselves to facts, but include their explanations; the facts are often distorted to fit. Do not rudely reject the explanation, but be very careful to note any probable bias it may have had, and try to eliminate it by suitable queries. Pain, the chief symptom, is difficult to describe accurately, but you need to know its

position, extent, frequency, duration, severity, and character.

• Patients, unintentionally, are most untruthful. For instance, it is very easy to extract the wrong tooth if you trust only to the patient's statements; because he feels sharp stabs of pain on the right side of his face, and with his tongue detects a big hole in an upper molar, puts the two facts together, and asks to have the bad tooth out. The molar may be a dead tooth with slight periodontitis, whilst the 'neuralgia' comes from an exposed nerve in a well-hidden cavity in any tooth on that side of the head.

BACTERIOLOGY.

Bacteria are plants belonging to the group of fungi—*i.e.*, plants containing no chlorophyll and absorbing nutriment from preformed organic substances.

They are subdivided into—

Eumycetes (higher fungi).

Hyphomycetes (moulds).

Blastomycetes (yeasts).

Myxomycetes (mycetozoa).

Schizomycetes (fission fungi).

It is the latter group with which we are principally concerned. They **require, in order to grow**, organic matter (carbohydrate, proteid, etc., for food), moisture, warmth, rest, and removal of their products, and each variety shows a nice preference for the particular kinds of food, amount of moisture, degree of heat, amount of free oxygen, and degree of alkalinity which they require, and will only flourish freely when a suitable environment is provided. Moreover, they sometimes war amongst themselves, one kind crowding out another kind, and sometimes mutually aid each other, two kinds growing together where neither can flourish alone.

But bacteria under favourable conditions not only **grow and multiply rapidly**, but they also **produce changes** in the surrounding materials. This action is called **fermentation**, and there are many different sorts of fermentation, according to the kind of bacteria and the nature of the surrounding materials. Several of these

are of interest to dentists, such as the acid fermentation which takes place when certain bacteria grow in a solution of sugar ; the **liquefying** fermentation that happens when certain bacteria grow on dentine ; and the poison-producing, or **toxic**, fermentation which takes place when certain bacteria (called **pathogenic bacteria**) grow in suitable material. A combination of the first two fermentations is the cause of **caries**, whilst by the third such diseases as stomatitis, gastritis, or **septicæmia** may be caused. Indeed, almost every known disease is caused by the growth of some special kind of bacterium, or by a combination of several kinds. Bacteria also do less harmful work, such as the production of various **pigments** and odours, and sometimes do useful work, as in aiding digestion or crowding out more harmful germs.

Fortunately for us **the body has safeguards** against the attacks of the harmful bacteria. Firstly, the healthy **skin**, or mucous membrane, affords a considerable barrier to the entry of the bacteria themselves, though their poisonous products at times may be absorbed. Germs also often so **change their surroundings** as to prevent their own further development, and sometimes one kind of germ prevents the growth of another sort. Again, only a few bacteria can find suitable conditions for life in the living tissues.

The **living tissues** of the body have certain powers of destroying the bacteria or their poisons (toxins). Some observers believe this power to exist in the body cells, others think it is in the plasma of the blood. These powers of resistance vary much in different people and at different times, and also towards different kinds of bacteria, and constitute either a **natural immunity**, when the antitoxins already exist in the body, or an **acquired immunity**, which may be either an

active immunity, produced by the inoculation of the person with weakened bacteria or weakened toxins, which stimulate the tissues to produce an antitoxin for themselves, each toxin causing the production of its own antitoxin, or a **passive** immunity, produced by the inoculation of the person with serum from an animal whose blood contains antitoxins. Hence it is very important to assist Nature by at once attending to all open wounds, ulcers, and sinuses, keeping the mouth and gums clean and the whole body in a state of health.

The mouth affords very favourable conditions for the growth of bacteria, and many varieties may be found therein. **Any kind** may occur accidentally, having been taken in with the dust in the air or on food, but not very many kinds ordinarily grow in a healthy mouth. Dirty mouths contain many more bacteria and kinds of bacteria than clean mouths. Of the **non-pathogenic** bacteria found in the mouth, *Streptococcus brevis* is the most constant, *Bacillus buccalis maxima*, *Spirillum putigenum*, *Spirochaeta dentium*, *Iodococcus vaginatus*, and *Crenothrix polyspora* are frequently present. Of the **pathogenic** bacteria, the pyogenic bacteria are not very commonly present, but the *Pneumococcus* and *Diphtheria bacillus* are often present; the *Tubercle bacillus* is common in the mouths of consumptive patients, whilst the *Micrococcus tetragenus*, *Oridium albicans*, and *Bacillus of actinomyces* are sometimes present.

From the presence of these bacteria in the mouth it follows that many fermentations and diseases may occur. Thus **caries** is the result of the action of acid-forming and liquefying bacteria; alkaline putrefaction and evil **smells** result from the action of other bacteria on proteid matter; various **pigments**, such as the green and orange stains on teeth, are produced; **inflammation** of the gums,

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periosteum, or pulp is also a result of bacterial activity ; and actinomycosis, tuberculosis, diphtheria, pneumonia, gastritis, and septicæmia may originate from the growth of particular bacteria in the mouth ; whilst the constant swallowing of toxic ptomaines may seriously damage the vitality of distant organs.

THE HYGIENE AND CARE OF THE TEETH AND MOUTH.

As the prevention of disease is the highest branch of medicine ; so it is the duty of dental surgeons to prevent as far as possible diseases of the teeth. It is, of course, unwise to coddle any tissue, or to introduce unnecessary, irksome, and meddlesome interference ; but we should teach and practise every process that will tend to effectively protect against disease with the smallest amount of interference.

It is best to begin at the beginning, and to teach parents that the teeth are forming during infancy, and that a proper diet, of human milk if possible, is necessary to their perfect growth ; also that all through infancy and childhood the jaws are developing, and some parts grow much faster than others, so that any check in the general health will very likely produce deformity which can never afterwards be truly cured. Good and appropriate diet, fully masticated as soon as teeth are present, and attention to the general health in infancy, are the only ways to prevent some incurable diseases of the teeth and jaws, such as hypoplasia and a shortening of the lower jaw.

It is only by proper exercise, inducing a healthy circulation, that any organ of the body will grow to perfection, and this applies to the jaws. It is, therefore, necessary for the child to thoroughly masticate its food,

and this it will not do unless all the temporary teeth are kept sound and **free from tenderness**. Children should be taught to masticate well, should be provided with food requiring mastication, and the temporary teeth must be as well cared for as the permanent ones.

Not only does the growth of the jaws depend on their proper exercise, but also on the growth of the neighbouring parts. Thus, the nose greatly affects the upper jaw. Unless the child **breathes freely and habitually through the nose**, the nasal cavities and bones do not develop, and a narrow, deformed upper jaw is part of the penalty. Children should be brought up to breathe through the nose, and not the mouth. Any obstruction to proper nasal breathing should be removed, and every effort made to restore the normal nose-breathing habit, in the day-time by taking exercise with the mouth resolutely shut, at night by wearing a loose rubber curtain under the upper lip to prevent air entering the mouth even when slightly open. Unless the proper **habit** is restored the operation is of little value, the teeth will remain prominent, become dirty, and the gums show red and soft, a certain preliminary to recession and pyorrhoea later on.

Thumb-sucking and comforters, or any habit likely to push the teeth out of place, should be forbidden.

After the period of growth is over proper exercise is still necessary to keep the teeth and jaws in good health. The **full mastication of food at meal-times**, and the prohibition of picking at food, or the sucking of lollipops in between whiles, is probably the most important factor in preventing caries of the teeth, inflammation of the gums, and also many other diseases of the alimentary canal.

The **nature of the food** is thought by some to be a very large factor in the great prevalence of caries nowadays, especial danger being attributed to the more

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readily fermentable forms of sugar and starch now used in foods; but we do not consider so much attention should be paid to the food as to the natural cleansing of the mouth by mastication, tongue, and saliva.

The use of fruit at the end of meals is a natural and valuable method of cleansing the teeth by provoking a good flow of alkaline saliva.

Second in importance to the natural cleansing of the mouth comes **artificial cleansing**, and here the direction of the dentist is required. In infants the mouth is, as a matter of course, cleansed after feeding and the daily bath by wiping it out with a piece of clean linen and a solution of borax or clean water. As soon as the temporary teeth appear a very small and soft brush will be more useful, and the child should be taught to use the brush himself morning and evening as soon as he is old enough to do so properly, care being taken to see that all the teeth are brushed crossways, and up and down, and on both sides and tops. Particular attention must be directed to the first permanent molars when they erupt.

For older children and adults a medium stiff small brush should be generally advised, to be used carefully twice a day at least, and oftener if convenient; soap, or soap with some powder mixed with it, should ordinarily be efficient.

But such instructions are not enough for all cases, and the results produced should be watched, and, where necessary, further directions given. In the case of **hypoplastic teeth**, powder and a stiff brush are usually wanted to keep the teeth bright; **irregular teeth** will require the use of a cane or a tooth-pick to keep in-standing teeth white, and to remove impacted particles of food. Where **tartar** has collected it will have to be removed by the dentist, and the teeth made perfectly smooth. **Green stains** usually

require the aid of a polishing stone to properly treat them, whilst the formation of a thick **soft white deposit** on the teeth can only be prevented by a most thorough and careful treatment of all the teeth and gums as a preliminary to regular brushing, and the instruction of the patient as to the necessity of proper mastication.

The use of silk between the teeth should not be encouraged in a healthy mouth: it is not needed; but when the interdental papillæ have become soft it is the only effectual way of cleansing, and the patient should be very clearly shown how to use it, so as to cleanse the teeth and yet not bruise the gum. Pass the silk gently up under the gum as far as it will go without hurting, and then rub to and fro whilst gradually withdrawing it towards the cutting edge of the tooth. As soon as the gum has shrunk sufficiently to allow of syringing through between the teeth the syringe should be used instead of the silk—it is less troublesome and less likely to injure the gum. Tooth-picks should also be used with care to scrape the teeth and not prod the gum; they should be of thin quill, gently inserted, and worked outwards and upwards.

A **periodical inspection** by a dentist is often of great use, as the prompt treatment of small carious cavities is easy and more satisfactory than when much damage to the tooth has taken place; also the formation of foci of infection and acid fermentation which would soon damage neighbouring teeth, as well as more distant teeth, can be prevented. Any inflammation of the gums can be treated and cured before it has taken a firm hold; tartar will never be allowed to accumulate. Irregularities may be prevented or easily treated, and any defect in cleanliness be at once pointed out and appropriate treatment indicated.

The dentist, in making such precautionary examina-

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tions, should examine the condition of the whole mouth as well as pay special attention to each surface of each tooth, and the smallest defects should be remedied where possible, that greater may not follow. When gingivitis is noticed its cause should be sought for, and the **risk of infection** from the mouths of the parent, nurse, or domestic pets inquired into.

When making such an examination of the mouth first draw up the lip and look at the whole upper set and their gum. The teeth should be not only clean but brilliant, and any loss of polish should at once suggest infection between the teeth from which an exudate has grown out on to the enamel surfaces. Painting the teeth with liquor iodi, etc., allowing it to run into all crevices and dry, and then directing the patient to rinse the mouth, will have the effect of staining black any such exudate and leaving the clean portions of the teeth perfectly white; thus the dentist can see where disease is, and the patient be convinced of the non-efficiency of his cleansing. The gum should be pale pink, stippled, and firm, and should firmly fill up all the interdental spaces, and it should not be possible to introduce a probe more than 1 mm. between the tooth and gum without drawing blood. The outline of the roots of the teeth should be visible and tangible, and the reflection of the mucous membrane on to the lip and cheek be marked by a paler line (health-line). Examine the lower set similarly, and then with mirror, wool swabs, and probe examine each tooth minutely.

The **general health** of the patient will naturally affect the condition of the mouth, as will also disease in the throat, tonsils, stomach, and naso-pharynx, and such diseases should be pointed out to patients in order that suitable remedies may be obtained.

Women in the early stages of **pregnancy** should have

their mouth properly put in order, as during the pregnancy and the suckling of an infant it is not convenient to visit a dentist, and during such times the teeth are exposed to extra risks from sickness, congestion, and neglect.

Mouth-washes are very seldom wanted for the prevention of diseases of the teeth and mouth, though often very useful in the treatment of existing diseases.

Occasionally **artificial teeth** are needed for the preservation of existing organs exposed to excessive wear or yielding to abnormal pressure, or to afford a function to a useless group of teeth, or prevent undue closing of the bite. Most scrupulous cleanliness must be urged on all who have to wear plates, and great care taken in their construction to prevent the lodgment of food.

It is the duty of all dentists entrusted by patients with the care of their teeth to see that the whole mouth is **clean and easily cleanable**, and free from all septic and carious foci, and from tartar.

ABNORMALITIES OF THE TEMPORARY DENTITION.

Of the process of **teething** we know very little, except that the tissues covering the teeth are absorbed, and that the teeth erupt in groups at intervals. This **normal** process is unaccompanied by any symptom as a rule, but occasionally some local irritation of the gum is caused, the gum becoming tender, hot, red, tense, and swollen. In dirty mouths **septic infection** may occur, and the local hyperæmia become an inflammation, local ulcer, spreading ulcer, or general stomatitis, according to the sort of infection and the general health of the infant. Also, the local irritation may cause a **reflex hyperæmia** in other parts of the head, and so exaggerate any existing disease, such

as otitis media, eczema, or cerebral irritability. The diseases arising from difficult dentition have been very much exaggerated, and much harm has been done by attributing to teething symptoms which should have led to the diagnosis and treatment of coexisting and more important diseases, such as rickets and gastro-enteritis. Only in cases where there is obvious local irritation over an actually erupting tooth is it right to lance the gum. Septic conditions of the mouth must be treated on the ordinary lines. Great care should be taken before and during the period of teething to prevent infection of the mouth. Perfect cleanliness of all food and feeding apparatus and the healthy condition of the mouths of all people likely to kiss the infant should be insisted upon.

Teeth may erupt before or after the usual time from no obvious reason, and a slight irregularity has no significance. Very early eruption of the teeth is usually the result of congenital syphilis. Late eruption is usually due to rickets, or the much more rare disease, cretinism. In both of these general diseases the late eruption is only one of many other examples of delayed growth of the body, and early treatment of the disease will tend to hasten the eruption. In cretins the teeth are structurally unaltered, whilst in rickets the follicle is said to be much thickened. As a result of this thickening of the follicle a **cyst** is sometimes formed over the tooth by the secretion of an extra amount of fluid between the follicle and crown.

The temporary teeth do not depart much from the average size, though the upper second molar is rather large at times.

There may be **too few** or **too many** teeth, the latter being the more common abnormality. Absence of many teeth is rare, and usually symmetrical. The tooth most frequently

absent is the upper lateral, as in the permanent set; but a temporary lateral may exist and yet not be followed by a permanent successor. The absence of the temporary teeth may be due to congenital malformation and be associated with other defects, or it may be the result of premature loss from disease or accident.

Extra teeth occur most frequently in the incisor region of either jaw, where they may be found as ordinary cone-shaped or tuberculous supernumerary teeth, as supplemental laterals, or geminated to the normal teeth. Supplementary supernumerary temporary incisors are usually, but not always, followed by corresponding permanent teeth.

No definite cause is known to account for these extra teeth. Some regard them as a hark back to the time when our forefathers had three incisor teeth, or had more than two sets of teeth; others think they are due to a bifurcation of the normal tooth-germ; others, again, as being due to an accidental inclusion of epithelium along the lines of developmental folds. It is seldom worth while to interfere with supernumerary temporary teeth unless they are obstructing the eruption of the permanent teeth, or are very unsightly.

The crowns of teeth are very seldom of exactly the same shape, and many variations in the proportions of the various parts are to be seen, such as an exaggeration of the antero-external portion of the cingulum of the first upper and lower molars. An extra cusp on the antero-internal aspect of the second upper molar of precisely similar pattern to that so frequently seen on the first permanent molar is the most common variation in form. Occasionally the crown of an incisor or canine is bifurcated, or it has an extra cusp developed on the lingual aspect.

ABNORMALITIES OF TEMPORARY TEETH

The roots also of the temporary teeth may vary. Thus lower canines and second molars and upper second molars may have an extra root in the same relative positions, as such extra roots are found on the corresponding permanent teeth. The roots of the molars vary in the closeness with which they embrace the developing premolars, so that in some cases it is impossible to extract the temporary teeth whilst their roots are complete without at the same time bringing away the developing premolar.

Hypoplasia is very rarely so extensive in the temporary set as in the permanent set, but it is not very uncommon to find temporary molars with numerous small defects in their enamel. Early erupted congenital syphilitic teeth are imperfectly calcified, and consist of a mere shell, which is soon shed.

Gemination is much more common in the temporary than in the permanent teeth. It consists in the fusion of two or more tooth-germs whilst still in the soft stage, or possibly in the incomplete division of one tooth-germ, and the subsequent calcification of the combined mass. We may thus find two or more of the normal series united together, or a normal and a supernumerary tooth, and the teeth may be completely or partially joined, and have a single or double pulp cavity. This abnormality is often symmetrical, and occurs in the incisor and canine regions of either jaw. Treatment is not called for unless the union cause one of the teeth to remain in place too long, so as to displace the permanent successor.

Early loss of the temporary teeth, apart from the results of caries or extraction, is rare.

Retention of the temporary teeth is common. The sound teeth which most often persist are the upper canines and the lower second molars; after these the second upper molars and the lower incisors. Such irregu-

larities are often symmetrical. Occasionally other teeth are retained, and in the cases where many of the permanent teeth are absent the temporary teeth may remain in use until late in life. Sometimes the permanent incisors or canines erupt behind the temporary teeth without loosening them.

Results of Retention.—Temporary teeth which remain late may rise up so as to remain in contact with the opposing teeth, or may remain at their original level, the alveolus always reaching to the neck of the tooth. In the case of teeth not rising there may be only an open bite in this region, or the neighbouring teeth may tilt in over them; and sometimes the gum overlaps them also, so that they may become encysted, out of sight, and on a level with the roots of the permanent teeth. Such encysted and impacted teeth are apt to form a lodgment for septic matter, and so lead to inflammation and an abscess, or the irritation may cause absorption of the roots of the neighbouring teeth. Caries also may be caused by the lodgment and fermentation of food about such teeth or portions of teeth. Retained temporary teeth, or portions of teeth, may deflect the permanent teeth whilst they are erupting and are only loosely held in their sockets, thus causing irregularities of position.

Causes of Retention.—Temporary teeth may persist because the permanent successors are absent, or very much displaced or delayed, and so the normal stimulus, which causes the development of an absorbent organ, is absent. Sometimes the temporary tooth is dead and septic, and so offers more resistance to the absorbent organ; or the crown may be impacted between its neighbours, and so the temporary teeth be the cause of the delay. Sometimes retention of the temporary teeth is a family characteristic.

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The recognition of retained temporary teeth is seldom difficult, and is often of importance, but it is frequently missed by students from want of careful observation.

Treatment.—As a rule such teeth should be removed as soon as it is time for their successors to erupt, and this is really of importance in the case of impacted teeth and pieces of dead roots. But should the retained teeth be firm, healthy, and in good articulation, it should be ascertained where the permanent successor is before extracting, as, in the absence or wide displacement of the latter, it will be better to leave the temporary tooth as long as it will last, often a matter of many years.

The temporary teeth at the age of two years should normally be in contact with each other, and at the age of six years a distinct space should have developed between the teeth. Hence, if the teeth are in close contact at the age of five or six years, they are abnormal.

A crowded condition at such an age may be due to mouth-breathing and consequent narrowing of the arch. A single tooth may be caught within the bite.

Open bite may be produced by an insufficient growth of the intermaxillary bones, mouth-breathing, or shortness of the ascending ramus of the lower jaw, as well as by the habit of thumb-sucking. In the latter case the abnormality is usually asymmetrical, confined to a few teeth, and accompanied by a backward displacement of the lower incisors. Treatment of open bite consists of teaching the child to breathe normally and forbidding thumb-sucking.

Edge-to-edge bite is not very rare, and leads to great attrition of the teeth. It requires no treatment, and the permanent articulation is usually normal.

Underhung bite is rare, as also is superior protrusion of the teeth not due to mouth-breathing.

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INJURIES AND DISEASES OF THE TEETH AND MOUTH IN CHILDHOOD.

Attrition of the temporary teeth is often seen, especially in cases of edge-to-edge bite, and it is usual to find the tips worn off the canines after eight years of age. Nature rapidly and easily protects the pulps of such teeth by the formation of a translucent zone in the dentine and a thick layer of secondary dentine in the pulp cavity.

Dislocation from violence may happen, but is of little importance apart from possible injury to the developing tooth-germ beneath. Early loss of the incisors does not lead to crowding of the permanent teeth.

Caries of the temporary teeth is common and important. The etiology, pathology, and symptoms are the same as for the disease in adult teeth. Perhaps during infancy illnesses are more common; cleansing is usually neglected unless insisted upon by the parents from the first, patent foods and milk and biscuits are often given after cleansing the teeth at night, and also sweet-sucking is allowed between meals, all of which are **predisposing causes** to caries. It is of the greatest importance that children should learn to **bite vigorously** and no tender tooth should be allowed to remain in the mouth; such teeth do far more harm than their loss can do, by the dirt around them, infection of other teeth and of the body generally, and by inducing weak, careful, and ineffectual mastication and cleansing. A pap diet will not teach a child to bite; give, then, food that needs real biting.

The **curative treatment** will have to be modified, as children cannot endure much pain, and are easily terrified; neither can they sit still very long. Small cavities, and those that can be cut to a retentive shape, should be filled with a silver-tin amalgam. Cement

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fillings are very useful if the whole of the cavity margins can be so placed as to be self-cleansing. If the cavities are very wide and shallow, **silver nitrate** may be applied several times at intervals of about a week, each time removing as much soft tissue as the child will permit, and rounding off and smoothing all projecting edges.

Exposed pulps in teeth, with **complete** roots, may be destroyed with arsenic, using only $\frac{1}{30}$ grain, and not leaving it in more than one day. When the pulp is dead, remove all the carious dentine and as much of the pulp as possible, and fill the pulp-chamber with iodoform paste; the roots may be left empty, or some of the paste gently packed into them. If the roots are **incomplete**, it is best to remove the tooth.

All unsavable teeth and pieces of teeth should be removed. Dead teeth should be extracted when their permanent successors are due to erupt. Any tooth which is causing **enlarged glands** in the neck should be speedily removed. Great care is necessary when removing pieces of temporary teeth not to injure the tooth underneath. In extracting temporary molars with complete roots there is a risk of bringing away the developing premolar, especially if there is much inflammation of the bone around. For the removal of temporary teeth a small elevator or large excavator is very useful. Cutting, with a sharp knife, the little bridge of gum near the neck of the tooth will allow necrosed roots with projecting apices to be easily tilted out.

The loss of the **second temporary molar** allows the first permanent molar to move forwards, and thus permanently reduce the room for the twenty anterior teeth. The early loss of the **temporary canine** will also allow the first premolar to move forwards and cause displacement of the canine; in fact, such loss almost

necessitates the extraction of a permanent tooth to restore order. The early loss of all the temporary teeth does not appear to hinder the growth of the jaws, though the loss of temporary teeth prevents proper mastication during an important period of growth.

Stomatitis.— Only a brief notice of stomatitis as it occurs in childhood can be given in a book of this size, as the treatment of such conditions seldom falls to the dentist. The most common form, and, indeed, the condition on to which most of the other forms are generally superadded, is **catarrhal stomatitis**, a moderately severe acute inflammation of the whole of the mucous and submucous membrane of the mouth. It may be caused by any local irritations, such as rough cleansing, too vigorous rubbing over an erupting tooth, too hot or irritating food, putrefaction of food in the mouth, or as a sequela of one of the exanthemata. The whole of the mucous membrane is tender, painful, hot, red, swollen, and there is a copious discharge of mucus and saliva: the child fears to take food, and the submaxillary lymphatic glands are enlarged and congested. Loss of weight may follow from lack of nourishment. **Treatment** consists in removing or preventing the cause, and cleansing and soothing the mouth with a borax or bicarbonate of soda mouth-wash gently applied on pieces of lint, and carefully feeding the infant with a properly dilute and clean milk. In more severe cases a 1 per cent. solution of nitrate of silver may be applied once a day.

Aphthous stomatitis is a catarrhal stomatitis to which is added the occurrence of numerous vesicles, much resembling those of herpes. The cause of this is not known, and the treatment is the same as above.

Ulcerative stomatitis is a catarrhal stomatitis which goes on to ulceration of the gums about the teeth, and

even to necrosis of the alveoli. It may be caused by scurvy, the administration of lead, arsenic, or mercury, or from an infection of the milk-supply. It principally attacks ill-fed, unhealthy children, but may also occur in adults. The mucous membrane about the teeth becomes more swollen, purple, soft, and loose, and then ulcerates, the ulcer spreading around neighbouring teeth and on to the cheek. The teeth are almost hidden, dirty, loose, and even fall out. The saliva is copious and the breath is foetid. There is much pain and emaciation and the lymphatic glands are enlarged. Fever of an asthenic form soon leads to death if the case is not treated. **Treatment** consists in gently and frequently cleansing the mouth, removing sequestra, and giving internally small frequent doses of chlorate of potash. Spoon-feeding and the administration of stimulants may also be necessary.

Thrush is a stomatitis caused by the growth of the *Saccharomyces albicans* in the epithelium of the mouth. It may occur in old, debilitated people as well as in children of poor health, and so has a rather bad prognosis. The growth produces white patches of mycelium, strongly adherent to the epithelium, surrounded by a red area of gum. The symptoms are those of a mild catarrhal stomatitis, with white, milk-like patches on the gum. **Treatment** consists in a somewhat vigorous cleansing of the mouth with a borax mouth-wash, and careful disinfection of all feeding apparatus. The patient must be regularly fed to maintain the strength.

Noma, cancrum oris, or gangrenous stomatitis, is a virulent, spreading, acute, gangrenous inflammation of the mouth due to some infective organisms. It usually occurs in debilitated children, especially after measles or other exanthemata. An ulcer forms on the inner side of the cheek, and rapidly spreads both laterally and also through

the cheek, causing coagulation and death of all the tissues it meets. The tissues are very swollen and doughy for a long distance around. The edges of the ulcer are red, with yellow and black sloughs or bare bone, and the child, though complaining of pain at first, soon becomes comatose and dies of toxæmia. **Treatment** consists in at once removing all dead tissues and cauterizing the margins and floor of the wound, whilst keeping up the patient's strength with stimulants and saline injections. The disease is usually fatal. If recovery takes place a plastic operation will be required to prevent contraction and closure of the mouth, but this must not be done too soon, as recurrence is not rare.

Children recovering from the exanthematous fevers, especially scarlet fever, are liable to an acute periostitis of the alveolus, leading to **necrosis** of the jaw, often symmetrically. Great care must therefore be taken to see that the teeth are all healthy during childhood, and when removing the loosened sequestrum be careful not to remove the developing tooth-germs, which often escape destruction by the disease.

ABNORMALITIES OF THE PERMANENT TEETH.

The **eruption** of the permanent teeth is greatly delayed in cretins, but prompt treatment with thyroid extract will remedy this. Rickets also will delay, or even prevent, the eruption of teeth. The follicle about such teeth becomes much thickened, and if fluid is excreted between it and the tooth a dentigerous cyst is formed. Poor children cut their teeth later than rich ones; girls cut their canines and second molars earlier than boys.

It may happen that in several members of a family the

canine teeth may be much displaced in their crypts, and therefore are late in erupting, having to force their way between other teeth or through extra alveoli; often in such cases the canines do not appear until late in life, when the alveoli are absorbed.

The impaction of temporary teeth, or death of their pulps, may cause delay in the eruption of their successors. Dilacerated teeth are late in erupting. Teeth may be impacted before eruption owing to the maldevelopment of one, the presence of supernumeraries, or to mechanical injury, and so be delayed in eruption.

The eruption of the **wisdom teeth** is very irregular as to time, and it frequently gives rise to trouble. Less severe trouble is sometimes caused by the eruption of the second lower molars.

Such trouble is usually much more severe and common in the lower jaw than in the upper. It is due to injury to the gum stretched over the crown of the erupting tooth, caused by biting on it, and to the putrefaction of food under the flap, the resulting swelling in either case making matters worse. Or it may be due to the eruption of the tooth in an abnormal direction—such, for instance, as pressing against the back of the second molar, or projecting into the cheek, or even into such distant places as the temporo-mandibular joint, the sigmoid notch, or under the chin. The **results** of such pressure may be the absorption of the tissues pressed on and sufficient irritation to cause pain and inflammation and trismus, and, should sepsis occur, ulceration, abscess, or even necrosis. The **treatment** of such cases is to keep the mouth very clean and as aseptic as possible during the eruption of crowded teeth, to apply astringents to reduce swelling, and, if necessary and practicable, to remove the flap of gum over the crown of the tooth. When the tooth is impacted, or



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trismus or suppuration has occurred, it is necessary to find the position and direction of the tooth and remove it if possible. If not possible, and there is much pain or dangerous inflammation, the second molar may be removed when the wisdom tooth is pressing against the back of it. Sometimes a surgical operation of some magnitude is necessary to extract a badly displaced wisdom tooth.

The teeth vary much in **size**; sets of large or small teeth are not uncommon. Of the individual teeth, the upper centrals and canines and the second lower premolars and lower wisdom teeth are sometimes very large, whilst the upper laterals and upper third molars are often small. Rarely one premolar or molar is found much smaller than its fellows. Care must be taken to diagnose large teeth from teeth geminated with a supernumerary tooth.

There may be **too few** or **too many** teeth, but no case of a third set has been authenticated. There may be total **absence** of both temporary and permanent teeth. Many permanent teeth may be absent, and in such cases the few teeth present are small, and usually consist of a pair of peg-shaped incisors and four permanent molars, with some retained temporary teeth. Of individual teeth, the upper lateral is the most frequently absent, either on one or both sides, and this abnormality is a very marked hereditary characteristic. The wisdom teeth may be wanting. The second premolars, more especially the lower ones, may be absent, the temporary teeth remaining *in situ*. The canine teeth sometimes do not erupt, but are always present. The absence of permanent teeth may be due to heredity, lack of room, to destruction of the tooth-germs by injury or inflammation, or to a germ developing into an odontome instead of a tooth. Several cases are recorded of abnormality of the hair being coincident with the lack of teeth, and imperfection of

the genital organs is often associated with defects of hair, voice, and teeth.

Extra or **supernumerary teeth** are common, and have been divided into two classes, according as they are peg or irregular shaped, or resemble closely the normal teeth, these latter being called supplemental supernumerary teeth. The former are the more common, and occur between and behind the upper centrals, and as many as four may be found together in one mouth. They lead to displacement and separation of the centrals, are unsightly, a hindrance to mastication and speech, and predispose to caries by the opportunities they afford for the lodgment of food. They should be removed, care being taken not to dislodge the normal teeth, as occasionally the roots of supernumeraries are twisted, and forcible rotation may knuckle out a neighbour; otherwise the operation is easy and free from danger, the roots being always single and conical. More taberculated supernumeraries also occur in the molar region on the buccal aspect of the third upper molars; they are often symmetrical. Such teeth should be carefully examined before attempting to extract them, as it sometimes happens that they are geminated to the true molars just below the neck, when an attempt at extraction would lead to an exposure of the pulp of the molar. Supplemental supernumerary teeth are most common in the incisor region, either as an extra upper lateral or an extra lower incisor, much more rarely as an extra premolar. In cases of cleft-palate and hare-lip an extra tooth is often found on the mesial side of the cleft, the true lateral being on the outer side. Various theories have been propounded to account for extra teeth (see p. 16), and the occurrence of the extra tooth on the mesial aspect of a cleft-palate is held to prove that it is the second incisor that is suppressed in man. On the other

hand, it is usually taught that the missing premolars in man are the first and second, as is the case in most mammals with diminished premolars, but supplemental premolars usually occur between the premolars and molars.

There are some variations of the **shapes** of teeth, so common that they ought to be known to the dental practitioner. Some are due to mechanical causes--for example, the curves so often seen in the roots of teeth which have moved or been pressed upon during development; and inasmuch as teeth far more commonly move forwards than backwards in the mouth (second premolars being the only teeth that at all commonly move backwards), the concavity of all such curves is behind. Teeth that have moved for only a short period will have a bayonet-shaped curve in the root. Lower molar teeth have a slight normal backward curve. Other examples are dilacerated teeth and the cramped roots of lower third molars. The concavity so often seen on the mesial aspect of the crowns of upper laterals is also probably due to pressure during development. Other irregularities of shape are apparently atavisms, such as the extra roots on molars and upper premolars. Some are due to disease, such, as Hutchinsonian teeth. For some we know of no cause, as enamel nodules, gemination, and odontomes generally.

The backward curve of roots has been noticed. Other general characters are the tendency for the centres of ossification to remain more distinct than usual, producing a primitive form of tooth with clearly defined denticles. Teeth may also tend to have many extra convolutions of the surfaces, and extra cusps and fissures. The cingulum may be very insignificant, or form a well-marked shoulder or extra cusp. Some teeth are squat with well-closed shallow fissures, whilst others have long cusps and deep, ill-closed fissures.

The most common variations in the crowns of individual teeth are the formation of a pit on the lingual aspect of upper laterals, an extra cusp on the antero-internal surface of first upper molars, the compression of the postero-external to antero-internal diameter of the crowns of both first and second upper molars to form the so-called 'oblique-rooted molar,' so called because in such teeth the posterior buccal root is displaced inwards and forwards. The lower second molar may have five, and the lower first molar have four cusps; an extra cusp may appear on the outer side of the lower molars.

In the roots, upper first premolars may have one root, or, more rarely, three roots; the second premolars may have two or three roots; an extra root placed between the anterior buccal and palatine roots of the upper first molar is very common; the posterior buccal root is very variable, small, and is often displaced inwards, and may be fused to the palatine root. Lower canines often have two roots; lower first premolars show a folding on itself of the cervical portion of the root and pulp cavity, approaching to the condition seen in monkeys; lower first molars frequently have a small round extra root on the inner side of the tooth, and usually nearer the back than the front; more rarely the anterior root is also bifurcated; second lower molars may have the two roots fused together. This may also happen in the third molar, or the anterior root may be bifurcated, especially if the apices of the roots are sharply bent backwards.

The sharp line of distinction between different kinds of defects and diseases so eagerly looked for by students and fostered by textbooks does not exist in nature, as any museum collection will prove, and no such line exists between abnormalities in form and abnormalities in structure. Gross abnormalities in structure affect the

form, and abnormalities of form and structure commonly coexist. Very thin enamel is usually very poor enamel.

Honeycombed, pitted teeth have many interglobular spaces in the dentine.

The specific gravity of teeth varies, and is a rough indication of the variation of their percentage of inorganic salts. The enamel prisms may be solid, homogeneous, and closely packed, or porous, striated, and show interprismatic substance. There may also be finer defects that we have not yet detected, such as an imperfect chemical union of the elements, for it is still believed that certain teeth are more susceptible to the action of caries than others.

Disease, local or general, pronounced or insidious, may cause defects in structure and form if it occurs during the growing period of the teeth.

Congenital syphilis affects the teeth earlier than any other diseases, and causes, in a few cases, a deformity of the tooth as well as imperfect calcification. The upper centrals are the most often affected, but the lateral incisors, the canines, and the first molars may also be deformed. In the incisors the centre denticle is deficient, and the side ones curve inwards, leaving a notch between them, so that the tooth is barrel-shaped and notched; the canines also show a notch at the apex, and the molars have very low, rounded cusps. The enamel and dentine of such teeth are imperfectly calcified. Typical syphilitic or **Hutchinsonian** teeth may very rarely be caused by some other lesion than syphilis.

Hyooplastic or honeycombed teeth may be conveniently divided into two classes, according as the damage covers a continuous large portion of the tooth or only affects a small strip or strips.

The first and much the commoner class is caused by

some long-continued deficient nutrition to the tooth-germ, such as may be produced by insufficient or improper feeding, rickets, or low vitality of the infant, and often lasts two or three years. The tips of the cusps on the first molars are calcified at birth and usually escape damage, but the enamel formed in the next two years is very thin, imperfectly calcified, opaque, and deeply pitted, and the dentine has many interglobular spaces, and the line of junction between the two tissues is very irregular. Thus about half the enamel of the incisors, the tips of the canines, and half the crown of the first molar, may be thin, pitted, brown, and friable. Often the upper lateral escapes with little damage.

Sometimes the disease is longer continued, and more of the teeth are damaged, and rarely all the teeth in the mouth may be defective. Other parts of the body also show coincident marks of injury, such as lamellar cataract of the lens of the eye and open bite.

In the **second** and less common class, only narrow bands of tissue are damaged, and this is caused by short illnesses of any kind severe enough to hinder nutrition—such, for example, as the exanthematous fevers—or a local injury, such as an alveolar abscess, and may affect one or several teeth.

Often the damage in either class is so slight that no visible outward effect is produced, whilst a microscopic section may show several brown striae of Retzius in the enamel, together with corresponding lines of Owen in the dentine; or a row of dots may be visible on the surface of the tooth. The enamel may be very thin, without marked defect.

Preventive treatment is the only efficient treatment (see p. 9); the damage once done cannot be repaired. Great care must be taken to thoroughly clean such teeth,

and a little polishing and even trimming off of rough edges may improve the appearance, and in very ugly cases in girls, by means of inlays and crowns the defect may be improved.

Another rare form of abnormal structure is the existence of **vascular canals** in the dentine. Such canals are most common in the roots of the teeth. They may be small prolongations from the pulp with smooth walls, and have dentinal fibrils radiating from them, or be very irregular, looking more like a cluster of interglobular spaces than a tube, and having the dentinal fibrils of the part deflected to either side of them, the clear space just around them being nourished by minute offsets from the canal itself. These canals are always present where enamel nodules exist. The much more common canals formed in dentine by absorption, as the result of chronic inflammation (see p. 69), and the canals produced by yeasts in extracted teeth are not described in this place.

The pulp may also have aberrant prolongations towards enamel nodules, as described above, and also into the crown of the tooth, the latter on rare occasions leading to an unexpected exposure from attrition or caries. Such prolongations when exposed must be either devitalized or capped. On the other hand, the root canals may be partially blocked by the formation during development of many irregular masses of dentine, quite apart from the results of disease or injury.

Gemination is less common among the permanent teeth than in the temporary set (see p. 17), but it may occur at any part of the mouth, though most common in the incisor region. Teeth joined together by layers of adventitious cementum are spoken of as ankylosed teeth, not geminated teeth, the latter term being confined to the congenital abnormality. It is rather difficult to exactly

classify gemination, as there is no hard-and-fast line dividing such a condition from enamel nodules on the one hand and supernumerary teeth on the other.

Very abnormal-shaped teeth and masses of tooth tissues which have no outward resemblance to teeth are classed as odontomes.

Odontomes,* or tooth tumours, are tumours derived from the special cells concerned in tooth development. Hence all odontomes must begin during the early years of life, though they seldom cause any symptoms till between the ages of twelve and thirty years. Some odontomes continue to grow the whole of the time they are in the jaws, others after a while cease to enlarge. Some are uncalcified and composed of soft tissues, whilst others are partially or completely calcified. They are mostly innocent tumours. The only symptoms they produce are those due to their increase in bulk, the absence of a normal tooth from the series, and, when they are exposed to septic infection, the resulting inflammation, or even necrosis. They are frequently much covered with cementum, as the result of chronic inflammation.

Odontomes are best classified according to their origin as—

1. Epithelial Odontomes.

In these the abnormal development takes place in the dental epithelium alone.

- (a) Multilocular Cysts.
- (b) Dentigerous Cysts.
- (c) Dental Cysts.

2. Composite Odontomes.

In these the abnormal development takes place primarily in the dental epithelium, and secondarily in the dental papilla, and may occur in the follicle also.

* See Report on Odontomes, British Dental Association, 1914.

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- (a) Complex Composite Odontomes.
- (b) Compound Composite Odontomes.
- (c) Geminated Composite Odontomes.
- (d) Gestant Composite Odontomes.
- (e) Enamel Nodules.
- (f) Dilated Composite Odontomes.

3. **Connective-Tissue Odontomes.**

In which the abnormal development takes place in the dental tissues of mesoblastic origin alone.

- (a) Fibrous Odontomes.
- (b) Cementomes.
- (c) Sarcomatous Odontomes.

Multilocular Cysts are groups of epithelial cysts commencing from a tooth-germ and growing to great size. They are more common in women than men and in the lower than the upper jaw. They should be removed by a surgeon.

Dental Cysts (see p. 65).

Dentigerous Cysts are cysts formed by the multiplication and degeneration of the epithelium about an unerupted tooth, which tooth, or part of a tooth, lies in the cyst. These are most common in rickety children, and may grow to a large size.

4. **Composite Odontomes** are calcified tumours and of limited growth. Practically they are very deformed teeth, and only cause trouble by their bulk, irregularity, or by affording an easy place for germs to lodge and cause severe inflammation.

Enamel Nodules are small enamel-covered nodules of dentine occurring on the roots of teeth. They vary greatly in size, and, indeed, range from small prolongations of the enamel below its normal level on the one hand to geminated supernumerary teeth on the other.

They occur almost always on the roots of upper molars, and are sometimes multiple. Enamel nodules appear to be due to part of the epithelial sheath of Hertwig becoming displaced and functional.

Each nodule consists of a cap of enamel, a body of dentine, and some indication of a pulp cavity. The enamel is thick in proportion to the nodule, with wavy interlocking prisms; it often shows brown markings when viewed by transmitted light, and may have fissures on its inner surface. It is sharply marked off from the dentine. The dentine often exhibits interglobular spaces, and there is some indication of a vascular supply to the centre of the nodule, either as a well-marked cornua of the pulp or as an irregular canal.

Enamel nodules are of only scientific interest, as they cause no clinical symptoms, and do not interfere with dental operations; in fact, they are never diagnosed until the tooth is extracted. They are interesting as remains of the epithelial sheath of Hertwig, and as possibly throwing some light on the origin of some supernumerary teeth.

Fibrous Odontomes consist of a tooth surrounded by a greatly thickened fibrous follicle, and are found in rickety children.

Cementomes are either calcified fibrous odontomes, the follicle wall naturally becoming cementum, not bone, or they may be calcifications in and about an aberrant tooth-germ.

The **diagnosis** of odontomes in their earlier stage depends on the presence of a slow-growing, painless swelling about the jaws, and the absence of a tooth, though this last is not always necessary. Later on, when inflammation has occurred, the difficulty is to determine the cause of the inflammation or necrosis, and in young subjects odontomes should always be thought of.

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The **treatment** consists in enucleation of the growth, restoring as far as possible any dilated bony walls, and keeping the wound well drained.

IRREGULARITIES IN THE POSITIONS OF THE TEETH.

Irregularities of the teeth may be **inherited**—*e.g.*, separation of the centrals, aberrant direction of the upper canines, and displacement of the incisors caused by hare-lip—or they may be the result of intermarriage between persons of different build or **race**, the inheritance of large teeth but only small jaws. Modern **civilization** causes irregularity, as may be proved by the greater prevalence of such among Europeans and Americans than savage races. How it acts is not so certain, probably by the far greater survival of the unfit, the use of much softer food, and perhaps even the diversion of blood to the brain causing less development of the jaws. Again, the narrow face being considered more refined, and men desiring refinement in their wives, may have led to the selection of the smaller-jawed women to propagate the species.

Malnutrition from any cause, such as starvation, improper food, illness, may produce irregularity. The teeth are formed, and attain full size early, and are apparently less affected as to size by illnesses than other parts, whereas the jaws grow gradually for many years, and are thus much more exposed to influences that may dwarf their growth. Moreover, certain parts of the jaw have at times to grow very rapidly to accommodate them to the development in other parts of the face, so that a period of arrested growth may not only produce smallness, but also deformity, by preventing the jaw from changing from the infantile to the adult form.

Lack of use of the jaws in infancy will prevent a proper blood and lymph supply, and hence smaller growth. Such lack of use may be due to the food being too much prepared, so that mastication is not required, or to the habit of swallowing food imperfectly masticated, or to tenderness of some teeth or part of the mouth, and it may affect part or all of the jaw. During the earlier months sucking is good exercise for the jaw. The development of the **tongue** may also affect the size of the arch.

Mouth-breathing is frequently associated with an irregularity of the teeth, and it may be that both abnormalities are the result of a common defective development; or mouth-breathing giving the nasal cavities no use, and so leading to their lack of development, may involve the adjoining parts of the palate and maxillary bones also; or the mouth being open, and therefore the tongue pressure being removed from the inner side of the teeth, whilst the cheek pressure is increased on the outer side, may lead to narrowing of the arch. Probably all these forces help.

There are also many **local causes** of irregularities. Thus the **retention** of temporary teeth or stumps easily deflect or rotate the loosely held erupting teeth. **Loss** of the second temporary molar allows the first permanent molar to move forwards, and so permanently lessens the room for the anterior teeth. Early loss of the first permanent molar, if the temporary molars are defective, may allow undue pressure on the incisors and a bad habit of mastication causing superior protrusion. **Super-numerary** teeth and attachment of an enlarged frenum of the lip far back in the mouth may cause irregularity of the incisors. **Thumb-sucking** and biting the lower lip may displace several teeth, and **cicatrices, tumours, and injuries** may displace teeth.

Whilst all these influences may cause irregularity of the teeth, it must be remembered that the action of the tongue, the cheeks, and the opposing teeth, tend to mould the teeth into a regular curve and good articulation, and that Nature tends to make the best of faults. For instance, deficiency of the length of the ascending ramus may be obscured by an increased range of movement in the temporo-mandibular joint, and the eruption of other teeth may close together separated centrals.

But uprising of the lower incisors in superior protrusion can hinder the treatment of such. Teeth which from neglect of early treatment of some small abnormality have become deflected out of the centre may go farther out of the centre, or partial open bite not treated early may be much more difficult to close when the teeth are impacted and settled. A natural cure may be produced by one tooth being shut out of the arch and the centre displaced.

Of the irregularities of **individual teeth**, the upper incisors may be internal to the lower teeth, usually as the result of retention of the temporary teeth. The temporary teeth should be removed in proper time, and the incisor pushed forwards. **Separation of the central incisors** may be caused by the pressure of supernumerary teeth, crowding of the roots, heredity, or the abnormal attachment of the frenum. **Overlapping** may be caused by general crowding, or be hereditary.

Separation of centrals should be treated by removal of the cause, if apparent. A slight separation or overlapping without obvious cause or due to heredity should be left untreated until all the teeth are in place.

Rotation of incisors is usually the result of retained temporary teeth or supernumeraries, or of crowding. Any remains of temporary teeth should be removed, and

careful note made of the bite. If this will tend to correct the irregularity, and there is no crowding, matters should be left to Nature for a while. If there is crowding, room should be made by wedging or extraction. When the tooth is caught in the bite it is apt to be damaged or pushed farther out of place, and should at once be treated by making room, if necessary, and then rotating the tooth. This latter may be done slowly by gentle pressure from wire springs or elastic bands, or quickly by forcible rotation with forceps, followed by the application of a splint for a fortnight. The **slow method** has the advantage of being painless, and not exposing the tooth to the risk of chipping by the instrument, complete dislocation, or destruction of the pulp; and should the root be twisted, bent, or impacted against other teeth, it will produce the best correction possible, the only disadvantage being that the patient must wear an uncomfortable, unsightly apparatus for some time. The **rapid method** greatly reduces the amount of apparatus to be worn by the patient and the time of its employment, but necessitates the administration of an anæsthetic, produces an open wound in the mouth, may damage or dislocate the tooth or its neighbours, and if the root is twisted or impacted will probably fail utterly.

The **upper canine** is often by a general crowding forced out of the arch, or it may take an abnormal direction and erupt far back or far forward, or into the palate.

When its displacement is the result of crowding, it is usually necessary to remove a tooth to make room, as expansion of the arch is seldom advisable. The canine itself is so hardy, powerful, and characteristic a tooth that it should very seldom be removed; the direction of the canine, if oblique, would indicate that the tooth nearest to the apex of the root should be extracted, as the crown

would more readily swing that way, and an upright tooth is more efficient and better looking than a very oblique one. The loss of a lateral produces a greater disfigurement than the loss of a premolar. The attempt to pull an uncrowded, maldirected and considerably displaced canine into place is often tedious and unsuccessful. Should the temporary canine remain, it is best to leave it. The badly malplaced permanent canine, if causing inconvenience or injury, should be removed.

Lower canines may be totally displaced and require to be removed, or may be crowded forward so as to give a fierce and ugly expression. They are usually best treated by extraction of the first premolar and retraction of the canine.

Premolars may be crowded, and then the second is usually forced into the palate. The displaced tooth should be removed if the others are sound. Early loss of the first molars often leads to a backward movement of the premolars, frequently accompanied by partial rotation. Such irregularities are best left alone. Retained temporary teeth or roots may lead to impaction and incomplete eruption of the premolars. Such temporary teeth or roots should, of course, be removed.

Molars are frequently tilted, usually forwards, rarely outwards, and sometimes inwards. This may be the result of the loss of a neighbour, maldirection of the tooth-germ, or heavy pressure. It is very difficult, and usually impossible, to treat. Prevention is very important, and extraction of the first molar should be avoided between the ages of nine and thirteen if possible, and a Woodhouse splint should be used when the first molar is removed to preserve room for the anterior teeth to move back. ⁹

Lower third molars are frequently troublesome, as they often have insufficient room to erupt and also often

erupt obliquely forwards and upwards, so as to impinge on the second molars. If there is ample room for the tooth to erupt, inflammation of the gum over it should be treated by cleansing the mouth and especially the surroundings of the tooth and the application of astringents, such as tannin and glycerine. It will be very seldom necessary to cut away any gum if this treatment is properly carried out. When there is very little room for the tooth eruption is long delayed, and food is very apt to collect under the gum and cause caries and inflammation. Still, if the patient is young and will take care to keep the mouth clean, such teeth usually in time come into place. When there is no likelihood of sufficient room being provided, or the tooth is impacted and causing pain, an attempt should be made to extract it. When this is impossible, or the second molar has been badly damaged by the impaction, the latter may be removed. When a sound and useful second molar has to be removed on account of an ill-placed wisdom tooth, it would be best to remove also the third molar and then replace the second molar.

General crowding, when there are more teeth than there is room for in a regular arrangement, may produce twisting and overlapping of teeth or displacement of one or more teeth without or within the arch—usually such teeth as have to erupt later than their neighbours, such as the second premolar and canine, the former having a bias inwards and the latter outwards.

Treatment consists in expanding the arch or extracting teeth. **Expansion** of the arch is a difficult and often unsuccessful operation, as the teeth have a great tendency to return to their former position. It should only be undertaken when the premolar articulation is defective, the upper premolars incline inwards, and the child's

general appearance will be improved by the new condition. **Extraction** is much more useful, and it then remains to select the tooth or teeth to be removed. The loss of an incisor is disfiguring; canines are strong, hardy teeth, and important in keeping the fulness of the face; premolars are less useful teeth, less reliable, and less noticeable. The loss of the first provides more room for the incisors than the loss of the second, and involves less disturbance. The first molar is the most valuable masticating tooth, and its loss provides little room for the incisors, and may cause tilting of the second molars, but it is often unsound. The apices of teeth move little, and hence the direction of the teeth is very important when choosing which to extract. The bite is an important factor in moving the teeth, and must be considered. The centre line should be thought of, and extraction so done as not to cause asymmetry.

Superior protrusion, or prominence of the upper teeth, often called 'buck teeth' by the general public, covers several conditions not yet clearly defined from each other. It may be produced by thumb-sucking or the presence of supernumerary teeth, and is then easily treated by the removal of the cause and retraction of the teeth. Sometimes it is caused by overgrowth of the anterior part of the maxilla, or by an abnormal development of the tissues derived from the naso-frontal process. It is often accompanied by narrowing of the arch. Inflammation of the alveoli of the incisors may be a cause at times.

Treatment is usually very difficult and often of little use. When the lower incisors bite on the roof of the mouth close behind the upper incisors, this obstruction to the backward movement must first of all be removed by grinding, extracting an incisor, or raising the bite by inserting an upper plate which articulates only with

the lower front teeth. Room has generally to be made at the side of the mouth by the extraction of a premolar, and the teeth then retracted by some mechanical apparatus. Afterward, a retention plate must be worn for a year. Sometimes, by using a plate with inclined planes, the patient may be made to acquire the habit of biting forward with the lower jaw, and so hiding the deformity.

Inferior protrusion, or 'underhung bite,' is mostly due to an overgrowth of the ascending ramus of the lower jaw, and is incurable, except by a double resection of the jaw. It may be due to defective development of the maxilla, and may occasionally be improved by drawing forwards the upper incisors, but the direction of the teeth when in their new place should not be very oblique. If the deformity is only a habit, it may be treated by elastic bands and a skull and chin cap. If mastication is very defective, artificial teeth may be of use.

Open bite may affect only the incisors, be limited to a variable region on one side of the mouth, or affect all the teeth but the second molars. It may be due to habits of sucking, impaction of teeth, extraction and tilting of teeth, or defective growth of upper or lower jaws. Beyond the prevention of the habit little can be done except cutting down the back teeth or extracting some.

CARIES.

Caries of the teeth is not a similar disease to caries of bone, except that there is a gradual loss of substance in both.

Caries of the teeth is a putrefaction, or fermentation, due to the action on the dental tissues of various germs. It is not a specific disease due to one special kind of germ, but a rotting away of the tooth from the action of one or

more kinds of germs which have the power either of producing acid or liquefying collagen, or of doing both.

The process starts outside the tooth by the production of acid from the fermentation of carbohydrate foodstuffs; the acids dissolve the lime salts, thus destroying the enamel and softening the dentine, and afterwards the collagen matrix is **peptonized** and also dissolved away.

There is very little if any, **vital reaction** on the part of the tissues. Enamel is dead, and therefore cannot react. Dentine is permeated by living fibrils; these, when first attacked, become more irritable and cause discomfort, and so give warning of the danger. They may then become calcified, forming a translucent zone, which offers more resistance to the acids and is less sensitive. The pulp, under the stimulation from the fibrils, becomes hyperæmic and more irritable; if not over-stimulated it will form new layers of dentine of various kinds, according to the age and condition of the pulp and the amount of stimulation, and thus attempt to protect itself. But all these barriers are seldom able to prevent the spread of the caries, and infection of the pulp by organisms and its suppuration and death are almost inevitable.

The principal acid produced in the mouth is **lactic acid**, though others may be produced or occur accidentally; and it is produced by the fermentation of carbohydrate material. Starch has to undergo a previous fermentation caused by the ptyalin of the saliva before the bacteria can convert it into lactic acid, but most sugars are directly fermentable. Protein when undergoing fermentation in the mouth becomes alkaline. Lactic acid fermentation is most rapid in a slightly alkaline medium. The organisms commonly concerned in this **acid production** are *Streptococcus brevis*, *Bacillus necrodentalis*, *Staphylococcus albus* and *aureus*, *Sarcinea lutea*, *alba*, and *aurantia*.

Acid production occurs in pits and fissures of the enamel, between teeth where they knuckle together, at the gum margins, or wherever food is able to lodge and rest. There is often a thin film of material covering teeth in which germs lodge, grow, and produce acid, though at other times such films appear to have a protective action.

When the enamel is dissolved or perforated by the acid, the dentine is decalcified, and then the peptonizing germs are able to grow and penetrate into it, following principally the tubes or rows of interglobular spaces. The germs commonly found liquefying the dentine are the *Bacilli mesentericus rubor*, *vulgatus*, and *fuscus*, *Bacillus furvens*, *B. gangrene pyogenes*, *B. fluorescens liquefaciens*, and *B. subtilis*.

These processes may be rapid or slow, superficial or penetrating, white or pigmented, according to local conditions.

Although the actual process of caries is now well understood, and its actual causes may be said to be the action of acids and germs, yet we are very far from knowing why caries occur so commonly in human teeth, and what brings it about in any special case, and hence treatment is still mainly directed to the repair of damage done rather than to the prevention of such injuries.

Many predisposing causes of caries have been suggested. Caries is far more common in civilized races than in more primitive people, but how civilization causes caries is not to be so clearly explained; it may be due to the survival of only the fittest among savage people, whilst in civilized races the weak and diseased are protected and kept alive; or the harder and less fermentable food and the more deliberate and thorough mastication of the

savage may produce better teeth and healthier mouths ; or breast-feeding in infancy and the active out-of-door life may lead to a finer state of bodily health, including that of the mouth.

The **structure and shape** of the teeth have been cited, as predisposing causes of caries. Many dentists believe they can tell a good from a poor tooth by its appearance, but chemical analysis and microscopical examination have so far failed to prove any such difference in teeth to exist, neither have they excluded its possibility, and the matter so far remains uncertain. Deep pits and fissures, or shapes that favour the lodgment of food between the teeth, must favour caries. **Crowding** of the teeth or **irregularities** of position that favour the collection of food and hinder natural or artificial cleansing also predispose to caries.

The salivary or mucous **secretions** of the mouth do vary in their properties, chemical composition, and reactions. It may be that some conditions are favourable to caries, others not ; but though this is very commonly believed, no actual proof has yet been produced.

Anæmia, pregnancy, and long febrile illnesses are often accompanied by much caries of the teeth, but the connection between them has never been accurately and certainly traced.

The **food** must influence the liability to caries.

Caries is practically unknown among purely meat-eating tribes, because proteid ferments alkali, whilst carbohydrate ferments acid. Then the carbohydrates vary considerably in their readiness of fermentation. **Cooking** renders most carbohydrates more easily fermentable. The food also varies in the ease with which it can lodge about the teeth, and in its solubility in the saliva ; and the preparation of food before cooking may render it more or less soluble, or fermentable, or adhesive.

The amount of lime in the water and food has been blamed, but it is difficult to comprehend how it acts if teeth vary so little in chemical composition.

Occupations exposing the workers to acid fumes, or the constant presence of flour, dust, or sugar in the mouth, will predispose to caries.

Lack of cleanliness is very liable to favour caries.

Caries is more common in **females** than in males, and more active in **youth**, than adult life.

But we are still far from knowing why an individual who has been free from caries sometimes has several carious cavities produced, followed, perhaps, by another long period of immunity, and even why some people constantly suffer from caries and others are exempt.

The **detection of caries** in an early stage is often difficult. **Inspection** may detect a white spot on the enamel, a small hole, an altered translucency of a part of the tooth, a darkening of an area, or the lodgment of food, and it is necessary to inspect every part of each tooth that is accessible. Then a **fine probe** may detect a widening of fissures and deepening of natural pits, and holes between the teeth or at the margin of fillings, or may pierce friable enamel or softening dentine, or cause pain when passing over an eroding surface. The passing of silk or strands of wool between teeth will detect roughnesses.

The patient may complain of **discomfort**, or of tenderness when sweet, salt, or cold substances come in contact with the teeth, or of pain when masticating.

But caries may occur without altering the translucency, and in places that cannot be inspected. Caries may penetrate to the dentine without causing sufficient destruction of enamel to be detected with light pressure with a probe, and very narrow fissures may lead to large

cavities. Pain is often absent in the early stages, and the degree of tenderness varies greatly, or the cavity may be so situated as to avoid irritation in ordinary mastication. Pain when felt is seldom easily localized, but there is always an increased sensitiveness of the dentine when first attacked by caries. Softness, and not discoloration, is the test of caries.

The **pathological anatomy** of caries consists of the destruction of **Nasmyth's membrane**, if present, by infiltration with germs to such an extent as to obscure all structure. A tough layer of soft tissue composed mostly of germs is often found adhering to the surface of enamel in the early stages of caries, and it is hard to say if this is altered Nasmyth's membrane or a product of germ activity. Its importance lies in the fact that it is very difficult to remove by the ordinary methods of cleansing teeth, and if it harbours acid-forming germs, by holding such acids in close contact with the teeth, it may greatly aid the process. On the other hand, it seems that at times such films may be protective.

In **rapid** caries of the **enamel** the interprismatic substances are first dissolved out, the individual prisms become more distinct, and their transverse striæ are well marked; the decalcifying action may reach the dentine before there is any macroscopic breach on the surface. When the caries is **slow** all parts of the enamel seem about equally affected, and the prisms, under the microscope, appear deeply pigmented. When the gaps are large enough germs enter and pieces of enamel are separated, so that a cavity is formed filled with germs, débris, and broken-off enamel prisms, and so on till the dentine is laid bare, when the acids penetrate sideways between the enamel and dentine more rapidly, and so the enamel edges are affected from below (*secondary caries of*

enamel), undermined and weakened. This lateral spread is very important to remember when preparing cavities for filling.

On reaching the **dentine** the acids sink in and dissolve the lime salts, spreading about equally in all directions.

Until the acids have softened the dentine no germs are able to grow into it. After this softening the germs are able to grow into the dentine, and they penetrate far more easily along the lines of the fibrils than through the matrix, unless there are interglobular spaces (*Owen's lines*), when the spread laterally will be as easy as penetration.

When the germs have entered the tubes they dissolve their walls, and so enlarge their lumen, at the same time, they render the sheath of Neumann very apparent; thus in transverse section the 'tobacco-pipe stem' appearance is produced. This enlargement is more rapid in some places than in others, in part due, apparently, to a lamination of the matrix, and so neighbouring tubes open into each other and form **liquefaction foci**; a continuance of this process will soon form an obvious hole or carious cavity. If the tooth is alive there is often, just beyond the softened area, an area of dentine rendered more transparent by the calcification of the fibrils; this is called the **translucent zone**. Even new layers of dentine may be formed in the pulp opposite the injured part if the caries does not spread too rapidly to allow of this attempt of Nature to protect the pulp.

The irritation of the fibrils and penetration of the acids will cause hyperæmia of the **pulp**, and when the germs reach it inflammation, and finally destruction of the **pulp**, will follow.

Cementum when attacked undergoes similar changes to dentine—first softening by acids and then the entry of

the germs, which follow the lines of Sharpey's fibres most easily ; but, as a rule, cavities in cementum are very wide and shallow rather than deep.

The spread of caries in dentine may be rapid or slow, penetrating or superficial, white or pigmented, and it may soften deep layers without forming any appreciable cavity ; but all such differences depend on accidental circumstances. The process is always essentially the same.

The **preventive treatment** of caries has been dealt with under the heading of Hygiene of the Mouth.

Curative treatment consists of the removal of all carious tissue and its replacement with some other material.

No attempt will be made in this book to teach operative dentistry, but several points may be spoken of.

When about to treat a patient suffering from caries, the dentist should make an examination of the whole mouth, and endeavour to ascertain the amount and cause of the mischief, and if any other diseases are present ; also the nature of the patient. The operator ought to make up his mind what ought to be done to make the mouth healthy and sound ; teeth that are causing pain should as quickly as possible be made easy, and by this means a better knowledge of the patient's ability to endure operation should quickly be gained, and some confidence in the operator's sympathy, care, and judgment engendered in the patient. After which the dentist should explain to the patient what is wrong and what he considers the best treatment, and should, if necessary, urge him to have proper treatment. It is wise to make as accurate a record as possible of the conditions found at once for future guidance. In cases of extensive disease, unless this preliminary examination of the mouth is very complete, it is very difficult for the dentist, to say how long or how

troublesome the treatment will be, and a guarded prognosis should be given—at least, until a few of the cavities have been excavated. A great deal may be done to save pain and time by means of cleansing of the mouth, removal of débris from cavities, and the insertion of dressing to push back flaps of swollen gum, and by temporarily arresting fermentation, giving rest to irritated pulps and gum. Removal of teeth should, when possible, be deferred until the mouth is reasonably clean. When preparing a cavity for filling, the removal of diseased or weakened tissue, the restoration of the pulp to health, the prevention of future disease, and the restoration of the tooth to its former usefulness, strength, and appearance must all be considered and as far as may be accomplished.

Though dental operations cannot be performed under aseptic conditions, yet every care should be taken to render all instruments and dressings antiseptic, and the utmost cleanliness observed in the operating-room.

INJURIES OF THE TEETH.

Concussion of the teeth. Teeth which have received a blow, insufficient to fracture or dislocate them, may yet have had the pulp and periosteum sufficiently injured to cause chronic inflammation, if the mouth is not quite clean. As a result the tooth may become stained by the exudation of hæmoglobin into the tubes, the pulp may die, and a chronic periodontitis be set up. This in time leads to absorption of the root, sometimes from the apex, producing short, stubby-rooted teeth; at other times affecting particular parts only, making communications between the pulp and periosteum through so-called 'vascular canals,' or even cutting the tooth in halves near the neck.

The symptoms are long-continued tenderness to pressure, and pain after exposure to heat, darkening of the tooth, some slight swelling of the gum margin, lengthening, and eventually loosening or spontaneous fracture of the tooth. Treatment to be of any use must be done early. The mouth must be rendered as aseptic as possible, and the bite eased from the tooth. If tenderness lasts over a week, or the tooth darkens, the pulp must be removed with most stringent aseptic precautions, and the root canal filled at once.

Attrition may be defined as the wearing away of the tooth substance by the grinding of one tooth's surface against another, **abrasion** being limited to the wearing away of tooth substance by foreign bodies. Two or three teeth only may be affected, but more often all the teeth are involved, and it may vary from the formation of a slight facet on the enamel to total removal of the crown.

Attrition is normal in old people and between closely packed teeth; it occurs quickly in deciduous teeth, the canines always having the cusps worn off before they are shed. Edge-to-edge bite is always complicated by it, and a crossed bite will produce local wearing. Very forcible mastication, the habit of grinding the teeth together, and the loss of many teeth, will all produce attrition.

The enamel may be worn away smoothly, or so as to form a jagged edge. The dentine will usually show a translucent zone, and some discoloration, and secondary dentine will be formed in the pulp, but not always quickly enough to prevent its exposure. Occasionally inflammation of the pulp and periosteum coexist. Some sections of much-worn teeth appear to show an increased brittleness in the enamel, as if from the action of acids.

Treatment is seldom called for. Irregularities of articulation may be corrected, lost teeth replaced by artificial ones to reduce the pressure on the remaining teeth, and the habit of grinding the teeth stopped, or even prevented at night by the interposition of a well-fitting soft rubber pad, tied to the patient's night-clothes to prevent it being swallowed. Hypersensitiveness of the dentine may be relieved by caustics, such as silver nitrate or zinc chloride.

The diagnosis of attrition may be of use to the dentist. For instance, in making a partial denture the facets may be useful, not only in demonstrating the normal articulation, but also as showing the movements of the mandible in the particular instance, for which provision will have to be made in designing the plate. Again, in the diagnosis of a persistent deciduous from a permanent tooth attrition may afford valuable evidence. As an indication of a powerful bite, attrition will act as a warning to make any necessary denture of sufficient strength, and the same indication will prepare the operator for unusual difficulty in extracting; or, again, when inserting a filling, care will be necessary to secure a firm hold, and a broad base for support must be provided. The presence of attrition may also account for certain pathological conditions of the pulp and periodontal membrane which have been mentioned. In certain cases the sharp edges left by attrition may cause irritation of the tongue or cheek. Attrition may be so marked and associated with such a strong and close bite that it becomes practically useless to fit the patient with artificial dentures, which would neither be comfortable nor useful under the circumstances. Grooves worn in the upper incisors will serve to show the necessity of securing a true impression of the tips of the lower incisors (without lengthening), and at least some of

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their anterior surfaces, if the models are to be accurately articulated.

Abrasion is caused by the mastication of hard food, or food containing grit, by the rubbing of artificial plates, and the use of hard tooth-brushes and gritty powder. In many cases a slight acidity of the oral fluids appears to greatly increase the rapidity of the process. Irregularity of the teeth will lead to some being much more worn than others, and the tooth-brush is often used with greater vigour on some parts of the mouth than on others. The holding between the teeth of tobacco-pipes, especially rough clay pipes, and of nails, as is the habit of some boot-makers, carpet-layers, and other workers, the tearing open of cartridges with the teeth, and the biting off of threads, all lead to the abrasion, and sometimes fracture, of teeth, and such wear marks are sometimes diagnostic of the worker's occupation.

Treatment, when required, will consist in the prohibition of the abnormal food or habit, and replacing the lost parts with fillings or crowns. Mere sensitiveness of the dentine may be treated by caustics or removal of the pulp.

Dislocation of fully formed teeth may be partial or complete. In the former case the tooth should be replaced, and also any broken alveolus ; some form of splint should be applied, and great attention given to the cleanliness of the mouth ; healing is generally rapid. If the tooth has come right out, it should, if clean, be at once replaced and held with a splint, when healing will occur as before, and the pulp probably regain its vitality. If not replaced at once, or if dirty, it should be cleaned, the pulp removed, and the canal filled, and, after removal of the clot from the socket, be replaced as before ; it will probably become fairly firm. Septic inflammation of the socket is the

chief hindrance to reunion. Replanted teeth are very liable to chronic periodontitis and absorption of the root.

Incompletely calcified teeth are sometimes driven down on to the calcifying part, or bent at an angle with it, and remain permanently so deformed. A too vigorous attempt to extract buried temporary molar roots, or a heavy blow on the temporary teeth, may bring about this accident. Such *dilacerated* teeth are often slow to erupt, appear in abnormal positions, and are extremely difficult or even impossible to regulate.

Fracture of the teeth. Teeth may be fractured by a direct blow or from forcible impact with other teeth, or with hard particles of food. Teeth weakened by caries or absorption may be fractured by very slight pressure. The fracture of the teeth during the attempt to extract them is dealt with elsewhere.

The fracture may only be a crack in the enamel, which will not require any treatment, though it may cause discoloration later on.

A portion of the enamel may be chipped off, and the biting of cotton threads is very likely to cause such an accident, especially in slightly worn teeth. Polishing and rounding the fractured surface is usually all that is required.

A part of the dentine also may have gone, without exposing the pulp, in which case there is generally considerable hyperæmia of the pulp and periosteum, with increased sensitiveness of the dentine. The tooth and mouth must be treated as for concussion, and the exposed tender surface of dentine should, if possible, be protected by some temporary dressing, or cauterized with zinc chloride or pure carbolic. When the acute symptoms have subsided, means should be taken to ensure that the fractured surface shall be kept clean, especially if it runs

up to or under the gum. It may be possible to lessen the defect by shaping the tooth with a polishing-stone, or restoring the part with a filling or crown.

The fracture may expose the pulp. If the tooth is not fully formed, an attempt may be made to preserve the pulp alive by capping it—a very difficult operation, as a rule—in order that growth may be completed. If this is impossible, the chance of crowning the root successfully decreases inversely with the length of the root. If it is thought that the neighbouring teeth will close the space without much tilting or deformity, the tooth should be removed. If it is decided to fill the gap with an artificial tooth, means must be taken to ensure the space being kept fully open.

When the root is complete, the pulp should be removed, the root dressed, and, as soon as the inflammation has subsided, crowning should be resorted to, the utmost care being taken to ensure a close fit, and no overlap or irregularity where food might lodge at the joint. Or the root may be extracted, if only a slight irregularity will result. In upper incisors the line of fracture often extends from just free of the gum margin in front to a variable distance below it behind, very greatly increasing the difficulty of exactly adapting a crown, and the liability to chronic periodontitis. In such cases it is sometimes possible to use the fractured portion as a crown by hollowing out the pulp cavity and firmly fixing a stout pin into it. The tissue should be kept from growing over the root while the crown is being prepared by some non-irritating aseptic dressing.

Fracture of the root entirely below the gum margin is sometimes difficult to diagnose. If the parts can be kept in undisturbed apposition and septic infection of the pulp avoided, union may take place by the forma-

tion of a rough secondary dentine and the addition of cementum.

Longitudinal fracture of the teeth or roots, such as may be caused by biting on a small hard substance unexpectedly, or by cutting off teeth with cutting forceps without previously making sufficiently deep grooves, is seldom treated with good success, as, although by means of a well-fitting collar the parts may be held together, absorption or caries usually soon destroys the root.

In the treatment of root canals injuries may be inflicted. The most common one is the pushing of **septic matter through the apical foramen** by careless manipulation. The result will be a septic periodontitis (see p. 69). Aseptic material, air, drugs, and clean instruments may also be pushed through, but usually only result in sharp pain of short duration and quick healing; but if the drug be a very powerful one, such as **arsenic**, or if there be septic inflammation about the neck of the tooth, the periodontitis may be very severe, and cause the loss of a tooth. If the **foreign body** is not removed, and though clean is sharp or rough, it may irritate the tissues and cause the formation of an absorbent organ, which usually erodes away the tooth much faster than the foreign body, and so after a long period of uneasiness and loosening the crown of the tooth finally drops out.

A **hole** may by accident be **drilled** in the side or apex of the root, and the periosteum wounded. Such an accident very much imperils the retention of the root, and requires very neat and careful treatment to avoid persistent periodontitis. Immediately the injury is discovered the root should be most thoroughly cleansed with a warm, non-irritant, but efficient antiseptic, the bleeding allowed to cease, and then a careful examination made. If the surrounding dentine is soft, the root very thin, or septic

periodontitis present, it is probably useless to try and save it, and extraction is the best treatment. If the periosteum is healthy, and enough sound dentine remains to carry a crown or filling without any large exposure of the periosteum, an attempt should be made to save the root. Complete the cleansing of the root, gently wash away the blood-clot till only a very thin layer remains, cap this as you would an exposed pulp with some aseptic, non-absorbent, non-irritant, permanent material, which exactly fits without pressing the surface, and will protect it from further mechanical injury. Soft gutta-percha, artificial dentine, osteo, and iodoform wax have all been used with success. After capping it is wise to wait a few days before completing the operation, for fear of failure, and precautions should be taken to prevent heavy pressure on the tooth or septic infection of the periosteum.

Foreign **bodies**, especially Morey drills, may become **impacted** in a root canal. This is generally the result of trying to enlarge a root canal without first obtaining a direct access to it in the line of its longitudinal axis in the proper way. By enlarging the canal with a trephine or drill it may be possible to seize and twist out the drill-head, with narrow forceps or special clutches, or steel instruments can be partly destroyed with iodine and then removed. Failing to loosen the instrument, an attempt should be made to render it and the root aseptic, after which, if successful, the root may be filled; but if unsuccessful the tooth will have to be extracted.

Erosion.—In erosion wide, open, not undercut cavities, with hard, white, smooth floors, are formed on the teeth, usually on exposed parts, accompanied by the formation of a translucent zone and patches of secondary dentine. Pain may or may not be present. These cavities are due to friction from the tooth-brush and powder. The patient

should be instructed to use a powder free from grit, but on no account should the vigorous cleansing be checked. If kept clean these cavities deepen very slowly, remain hard and free from tenderness or decay, but if allowed to get slightly unclean they quickly become tender and sensitive to cold. By filling one such cavity the tooth-brush may be prevented from effectually cleansing neighbouring cavities and these will at once go wrong. It is therefore better to leave these cavities alone so long as the patient effectually cleanses them, but if one has to be filled then the neighbours should be also restored to contour.

DISEASES OF THE PULP.

The pulp of a tooth may be **congenitally deformed** when the tooth-germ is aberrant in growth, but such conditions are treated of under the heading of Odontomes (p. 33), or of Dilaceration (p. 55). Nevertheless, minor deformities of the pulp, associated with insufficient external deformity of the tooth to be classed as an odontome, or even to cause clinical symptoms, do exist. In several cases of enamel nodules that have been examined there has been some extension of the pulp towards the nodules; in three cases an enamel nodule projected into the pulp cavity. The pulp may also be much obstructed by masses of pulp-stones and irregular dentine from irregularities of growth during development.

Degenerations of the Pulp.—The pulps of old teeth and pulps that have been injured by chronic inflammation may degenerate. Changes in the circulation in the peridental membrane will often cause secondary changes in the dental pulp. They may undergo **fatty degeneration**, the cells and tissues being gradually converted into fat; or **fibrous degeneration**, the cells of the part disappearing, and nothing but the fibrous element remaining;

or **calcareous** degeneration, which term has been made to include both infiltration of a degenerated pulp with lime salts, and also the formation of **pulp-stones** and **secondary dentine** within the pulp. Pulp-stones start either from little masses of calcoglobulin, which are sometimes found in normal young pulps, or around some small foreign body, and are built up layer by layer till they almost fill the pulp cavity. When examined under a microscope this layer-like arrangement is readily seen. Pulp-stones are often found in the teeth of young gouty patients.

Degeneration, when unaccompanied by inflammation, leads to the gradual loss of sensibility of the pulp. Pulp-stones sometimes cause acute pain, and very greatly increase the pain caused by a pulpitis, such as follows the application of arsenic; they also prevent the penetration of the arsenic, so that an anæsthetic is required in order to remove such pulps.

There are no new growths or tumours found in the pulp.

Active hyperæmia of the pulp is usually accorded a separate description in dental textbooks, for no very obvious reason, as it is only an early stage of inflammation. **Passive hyperæmia** will be described under chronic inflammation.

Active hyperæmia is a condition of increased blood-supply from dilatation of the arterioles.

It is produced by any source of irritation great enough to injure the vessels, and yet not enough to cause inflammation, such as pulp-stones, concussion, thermal changes, or the irritation of the dentinal fibrils by attrition, erosion, caries, drugs, sweet or salt substances—recession of the gum predisposing to it very much, as also will feeble health, gout, and a very nervous constitution.

The pathological conditions found are usually trans-

lucent zones in the dentine, patches of secondary dentine and a pulp with irregularly dilated vessels and proliferating cells. After a while degenerative changes occur.

The symptoms consist of marked tenderness, producing acute transitory pain when irritated, by which it may be diagnosed from inflammation, in which the pain is more lasting. The dentine may be far more sensitive and tender to excavation than usual. •

The prognosis is usually good, as little damage has been done. •

Treatment consists in protecting the pulp from irritation, either by covering the exposed part with a non-irritant and non conducting filling, or by destroying the vitality of the fibrils with caustics, so that sensations are less readily conveyed to the pulp. If caries exists, the carious tissue must first be removed, and in order to reduce the tenderness sufficiently for the patient to permit this to be done, after removing as much caries as possible, the use of a temporary dressing over the remaining dried carious dentine for a few days is very useful; a mixture of Fletcher's artificial dentine, carbolic acid, and cotton-wool is very effective. The use of an alkali, such as hydrate of magnesia, alternately with an antiseptic mouth-wash will also often be of use in temporarily checking the disease and reducing the tenderness of shallow cervical cavities. At the same time, an attempt to relieve the congestion of the pulp by means of counter-irritants to the gum, a saline purgative, and attention to any general ill-health should be made, and particular attention must be paid to the thorough cleanliness of the interdental spaces and gum margins of the affected and neighbouring teeth. If the hyperæmic condition does not rapidly improve, the pulp should be exposed under an anæsthetic, removed, and the roots filled.

AIDS TO DENTAL SURGERY

INFLAMMATION OF THE PULP.

Acute inflammation may be either simple or, much more commonly, **infective**.

It is caused by wounds, exposure of the dentinal fibrils to irritation, arsenic, pulp-stones, caries, infection from the mouth or via the periosteum.

The resulting changes may be localized to one part or spread throughout the pulp. The usual dilatation of the vessels, exudation, stasis, and proliferation of the cells takes place, but **resolution** seldom occurs even when the irritation is removed, because the pulp cells are very delicate and are tightly enclosed. The exudation of hæmoglobin is apt to stain the dentine and darken the tooth.

Organization will be spoken of under chronic inflammation. In the case of an acute localized inflammation of the pulp due to an exposure of the pulp by a clean drill or a fracture of the tooth, the pain is very acute at the moment, but may quickly subside, and if care is taken to prevent infection recovery is to be expected.

When **capping the pulp** let the bleeding cease, wash away all but a very thin layer of the clot with some warm non-irritant antiseptic, and then cover with some close-fitting, aseptic, non-irritant, non-conducting, permanent material, which must be fluid enough to fit exactly without pressure, and yet set hard enough to prevent pressure from the subsequent filling.

Capping a pulp exposed by caries is far less likely to be permanently successful, as more extensive damage has been done, and instead of a healthy pulp there are only scar tissue and irregular patches of secondary dentine; also such exposures are often much wider than they appear to be, and are very difficult to effectually disinfect.

Suppuration is by far the commonest termination of

acute pulpitis, and may occur on the surface as an ulcer, or as a number of small abscesses, and gradually destroy the whole pulp. **Gangrene** may also happen either as a result of virulent infection, or from strangulation of the apical veins and consequent stoppage of the circulation.

The symptoms of pulpitis are severe, intermittent, unlocalized (hence often called neuralgic), lancinating pain, lasting from a few minutes to several hours, worse after exertion, mastication, or lying down; great tenderness to light pressure on the exposed pulp, to heat, and sometimes to cold, so that the tooth is usually avoided when masticating.

Treatment consists in removing the pulp and solidly filling the root. Temporary relief may sometimes be obtained by the application of carbolic, oil of cloves, brandy, or cocaine, and a light dressing. Capping has been described above. In cases where removal of the pulp is not practicable, if aseptic it may be 'mummified' and left, and in some cases a septic pulp may be, by frequent disinfectant dressings, rendered sufficiently aseptic to be 'mummified,' but such practice is always to be avoided, because of its uncertainty and the liability to future infection via the crown or the periodontal membrane. Teeth that have become darkened by hæmoglobin should be bleached as quickly as possible.

Chronic inflammation is less severe in type and slower in terminating. Passive hyperæmia is indistinguishable from slight chronic inflammation.

It is due to a lesser degree of irritation, more prolonged, and predisposing general causes of inflammation are usually more noticeable.

The vessels remain in a dilated condition with a slow flow of blood, exudation is less, proliferation of tissues more, and degenerations are common. Resolution does

net occur. **Organization** is more common than with acute inflammation, and usually takes the form of a patch of adventitious or **secondary dentine** opposite the source of irritation. This new dentine will vary in character with the age of the pulp and severity of the inflammation, and may be fibrillar, hyaline, areolar, or totally irregular in structure. Or, on the other hand, cells may be formed that will absorb the dentine, and greatly enlarge the pulp cavity. Or a mass of granulation tissue may be formed, and project into the cavity as a **polypus** of the pulp, which, when old, becomes very fibrous at the neck, and frequently ulcerated on the surface, where masses of endothelial cells may be found.

Suppuration is a still commoner termination of chronic inflammation, and usually occurs as a slow progressive ulceration.

Of course, different changes may be going on at the same time in different parts of the pulp, or at the same place at different times, so that, for instance, a pulp with a polypus projecting into the carious cavity may show an enlargement of the apical foramen, and the formation of several 'vascular canals.' Or a section might show that the pulp cavity had at one time been enlarged, and later filled up with secondary dentine.

The pain from chronic pulpitis may be nil, or of much less severity than when acute, but at times it is dull and continuous, though unlocalized; the tenderness also may be much less, though heat will usually bring on pain. Subacute attacks often occur during chronic inflammation, with accompanying severer symptoms; also a certain amount of periodontitis often complicates the diagnosis.

Polypi of the pulp are not sensitive unless the pedicle is pulled or crushed into the pulp, and they do not bleed readily.

Chronically inflamed pulps, if giving any pain, should be removed, and the roots solidly filled. If calcification has closed the root canals so that they cannot be cleaned (the canals are never totally blocked), cleanse the pulp chamber as far as possible, apply a strong disinfectant dressing for a few days, and, if all remains comfortable and free from odour, 'mummification' may be done with every prospect of success. Great care must be exercised in treating teeth with enlarged apical foramina or 'vascular canals' not to irritate the periosteum, which in all such cases is also inflamed. Chronically inflamed, almost disposed pulps that only occasionally give trouble, but are often very tender, may, if very gently treated by partial removal of caries and the use of temporary antiseptic dressings, be so far improved that organization will take place, and the cavity eventually be soundly filled.

DISEASES OF THE PERIOSTEUM.

Congenital malformations of the periosteum are few. **Follicular odontomes** might be counted as such, and the persistence of parts of the enamel organ, as the so-called **glands of Serres**.

Fibromata or epulides usually arise from the dental periosteum, but will be described with tumours of the gum (see p. 98) and myeloid sarcomata (see p. 111).

Dental cysts are produced by the irritation of the periosteum by septic matter from dead teeth causing growth of the glands of Serres. First there is an ordinary chronic inflammation and a formation of granulation tissue; then the epithelial cells proliferate, those on the surface of the mass forming long outgrowths. At this stage the mass of epithelial cells and granulation tissue is

spoken of as an **epithelial root tumour**. Later degeneration of the cells in the centre takes place, to form an albuminous fluid containing much cholesterine, and so the dental cyst is produced. This process continues, and quite a large cyst with fluid contents, and lined internally with degenerating epithelium, then growing epithelium, and outermost of all granulation tissue, may be found. The bony parts around will be absorbed on the inner side by rarefying osteitis, and built up on the outer side by osteoplastic periostitis, so that the bone appears to be expanded. Usually, after a while, the rarefying exceeds the building up, and so the bony wall is perforated.

Such a cyst will cause no pain, heat, nor redness of the parts, but will slowly increase in size, presenting at first a hard rounded outline (liable to be mistaken for an osteoma, though the latter are irregular, and usually multiple); then a larger swelling with bony walls so thin that they can be bent by moderate pressure, and give a sensation like the crackling of an egg-shell; and later still having no bony wall, so that fluctuation can be easily felt. When they have reached a large size, it is very common for dental cysts to become infected, inflamed, and suppurate. There always is, or has been, a septic root close by. The cyst may spread into the antrum, pushing the mucous membrane before it.

Treatment consists in removing a large part of the walls, properly draining the cavity, and allowing it to heal up from the bottom.

Epithelioma sometimes commences in the dental periosteum.

INFLAMMATION OF THE PERIDENTAL MEMBRANE.

Inflammation of the peridental tissues, or periodontitis, includes a great variety of clinical conditions, such as exostosis, pyorrhœa alveolaris, necrosis of the jaw, alveolar abscess, gumboil, and recession of the gums, and is intimately connected with gingivitis and stomatitis. It is thus very difficult to describe in an instructive manner. It will be attempted to arrange the facts under the headings of ætiology, pathological anatomy, symptoms, diagnosis, prognosis, and treatment of simple periodontitis, and then describe the periodontitis due to specific drugs and germs separately.

Ætiology.

The actual causes of periodontitis may be classified as .

Traumatic, such as blows, wounds, over-use, pressure of ill-fitting plates or clasps, too rapid regulation or separation of the teeth ; impaction of one tooth against the root of another ; irritation from a rough cervical edge of a filling ; accumulation of food between teeth ; too vigorous use of a tooth-brush, cane, tooth-pick, or silk ; the lodgment of loose tooth-brush bristles, fish-bones, or rubber bands ; careless application of clamps, or slipping of excavators, etc. ; the escape of arsenic, caustic potash, or zinc chloride on to the tissues ; the presence of tartar ; the passage of an instrument through the side or end of a root canal, or forcing of the pulp canal contents or irritant drugs through the apical foramen ; the pressure of new growths ; and the excretion of drugs such as mercury.

Infective.—Germs may be conveyed to the periosteum through the gum, through the apical foramen or accessory foramina of the tooth, or be brought by the blood, or by

The extension of inflammation from neighbouring parts. The bacteriology of periodontitis is at present very incomplete, but many kinds of germs have been noticed. Under the heading of 'Infective' will be placed periodontitis due to tubercle, syphilis, typhoid, the exanthemata, ulcerative stomatitis, cancerum oris, and acute idiopathic periostitis.

The **predisposing causes** will include the usual general predisposing causes of inflammation that apply to all tissues, such as old age; venous congestion; unhealthy blood-supply, as in alcoholism, diabetes, lead, mercury, and iodine poisoning, gout, sapremia, and syphilis, or in albuminuria, anæmia, scurvy, and purpura; also local impaired blood or nerve supply; a previous injury; cold to which the jaws are much exposed; and a septic condition of the mouth. It must be remembered that the gingival margin is the most septic part of the mouth; that lead, mercury, and scurvy affect the gums especially, and that a tooth once slightly raised in its socket is exposed to continual over-pressure.

Pathology

When the periodontal membrane is inflamed, the blood-vessels in it and the surrounding bone and gum become dilated, and the rate of the blood-flow increases. If the irritation is more severe at one part, the flow there will slacken, oscillate, and finally stop. At the same time there will be an exudation of lymph and leucocytes, and, in the most severe cases, of red blood-corpuscles also; so that the periosteum and gum are thickened, red, and soft, and under the microscope show a large number of cells among the fibres. In the bone, the Haversian canals contain exuded cells, which are very apt to absorb part of the walls, enlarging the canals—a process known as rare-

lying osteitis. The normal cells of the part are softened or proliferate.

These changes may affect only a small part of the peridental membrane and bone, or may involve the whole membrane and the tissues for some distance around, according to the cause and condition of the parts.

Should the irritation cease at this stage, before the vessels of the part are thrombosed, **resolution** will occur, the vessels contracting, the flow returning to the normal rate, and the exuded cells and lymph being carried off by the lymphatics.

Should the irritation continue, but only in a mild form, or should the vessels have become thrombosed before the irritation ceased, **organization** will take place. Organization may be productive or destructive: the former when the irritation is very mild, and the latter when it is more stimulating.

In **productive organization** the bloodvessels are slightly enlarged, the flow little above normal, exudation and proliferation not very great. Any layers of lymph exuded on to the surface of bone or cementum will become impregnated with lime salts, and any cells lying in it be surrounded by a new formation of bone or cementum. The process is spoken of as osteoplastic periostitis, sclerosing osteitis, or **exostosis**, according as it occurs on the surface of a bone, in its substance, or on the root of a tooth. Very rarely this results in the ankylosis of a tooth to the socket.

In **destructive organization** the vessels are more dilated, the flow accelerated, and the exudation and proliferation more active. The exuded cells, either as leucocytes or as giant or myeloid cells, destroy the normal cells of the part, and remove the lime salts, replacing them with a mass of granulation tissue. This process is

spoken of as rarefying osteitis when it occurs in bone, **absorption** when it attacks the tooth. The small crescentic hollows made in the hard tissues by the cells are called **Howship's lacunæ**.

In actual practice these two forms of organization usually go on side by side, building up and thickening tissues just beyond the area of sharp stimulation, and eroding it away and rarefying it in the centre of irritation; or the processes may alternate at the same spot, according as the irritation or recovery of the tissues is most pronounced. When such alternation has resulted in the removal of normal cementum and dentine, and, later on, the filling up of the gap with new, more cellular cementum, the process is sometimes spoken of as **inostosis**.

One peculiar result of chronic septic irritation of the periodontal membrane is the simulation of the so-called glands of Serres, epithelial remains of the sheath of Hertwig, and the production of a **dental cyst** (see p. 65).

Suppuration may occur, either in the form of an ulceration spreading from the gum margin, usually known as **pyorrhœa alveolaris**, though this term is now often made to include the earlier stages of inflammation of the gum, and periodontal membrane; or as an abscess at, or near, the apex of the tooth, which is known as an **alveolar abscess**, and, later on, when it has burst and formed a sinus on the gum, as a **gumboil**.

The process of **ulceration** is not always called **pyorrhœa alveolaris**, as, for example, when it is due to the action of arsenic escaped on to the gum, or the pressure from an elastic band left on a tooth, the term **pyorrhœa** being applied more to the chronic cases, where there is no obvious local cause other than the presence of **tartar**. But it will be better to ignore the rather unsatisfactory terminology, and to describe the process.

There is an initial stage of inflammation, which may be slight or severe, followed in the former case by more or less protracted stages of inflammation, usually leading to a thickening of the alveolus on its outer surface, an enlargement of the tooth socket by absorption from its inner surface, and a general softening and destruction of the fibrous tissue of the part and its replacement with granulation tissue. In the more rapid cases no new alveolus is added. Finally, the cells on the surface are destroyed, and ulceration has commenced. This ulceration may spread down on all sides of the tooth equally, but usually it does so much more at one place than at others, forming deep pockets round the teeth, from which pus exudes. These pockets drain badly, and so the septic materials are kept in contact with the tissue, and render healing very rare, whilst they produce a large amount of infective material, which movements of mastication and speech may spread to other teeth. The discharge also may enter the stomach, and cause inflammation and loss of function there, or may enter the circulation through absorption by the lymphatics, and set up local or general diseases (see p. 127).

When the process starts at the apex of a tooth root it is usually caused by germs growing through the dead pulp tissue, or by a portion of septic matter being driven through the apical foramen by the force of mastication, the evolution of gas in a closed pulp chamber, or the use of instruments. There will be an initial stage of inflammation extending to a very variable distance around according to the severity of the infection and health of the tissues; there may or may not be a period of chronic inflammation and organization, during which tissues may be very much altered; finally, the cells most irritated will die and liquefy, forming with the fluid exuda-

tipn the liquor puris. At this stage a section of an alveolar abscess would show the root of the tooth with the pulp dead and septic, the dentine unaltered, the cementum probably thickened a little distance from the apex; the periosteum hyperæmic throughout, the more distant parts showing increased flow of blood and exudation of lymph and a few cells; nearer the apex, retarded flow and greater exudation; close to the apex, stasis or thrombosis of the vessels, and many exuded and proliferated cells, many of them dead, and those in the centre fluid. The bone also will be hyperæmic, and show exudation of cells; far from the irritation the changes will be constructive—an osteoplastic or sclerosing osteitis; nearer the centre the Haversian canals will be enlarged by absorption, as also will be the inner surface of the socket—a rarefying osteitis. Or, as before mentioned, these changes may occur in already disorganized or sclerosed tissues, in which case destruction is apt to be rapid and widespread. More pus is formed by the death of the cells next outside, and so the inflammatory zones will spread outwards and the abscess enlarge, spreading, as a rule, more rapidly through the bone than along the periosteum, until the abscess bursts on some surface.

An abscess, after bursting, may heal up by the restoration of the circulation in its walls, the growth of granulation tissue, and final cicatrization.

But such sound healing is very unlikely to happen, because septic matter still remains at the apex of the tooth; or small particles of the bone have necrosed; or the root end has had its periosteum destroyed and the cementum soaked in septic matter, or has been rendered rough by absorption; also, new germs have entered from the external orifice to keep up the irritation, and, as gum recovers more quickly than bone, the opening will

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heal before the deeper parts, and thus prevent proper drainage.

Often, the root having been cleansed inside, healing takes place, but leaves a certain amount of septic material encapsuled within the bone, which lies dormant whilst the individual and the parts are in good health, but re-forms an acute abscess whenever the vitality is lowered or the parts are injured, as by cold, vibration, over-use, etc. This condition is known as a **chronic gumboil** or dental sinus. The root may be normal, or have the apex bare of periosteum, or be partially absorbed; a little nearer to the neck the cementum is exostosed, the periosteum has lost its original structure, and is replaced by granulation or scar tissue in various stages of destruction; the apical space is enlarged, and the fibro-cicatricial tissue lining its inner surface may be sufficiently fibrous and adherent to the root to come away with it, forming the so-called 'abscess sac'; the bone has been absorbed to enlarge the socket, and small pieces may have necrosed; that left will be sclerosed and poorly supplied with blood, though during an exacerbation it may again undergo rarefying osteitis. The track or sinus leading to the gum will be, as a rule, tortuous, and lined with granulation tissue, the contraction of the walls causing the inner layers to project on the surface as a small pimple. A gumboil may open at some distance from the tooth causing it, and in old cases the recrudescient abscess may be also far enough away from the tooth to cause no discomfort in it.

An alveolar abscess does not always burst into the labio-dental sulcus; it is more common for those attached to the upper lateral teeth and the palatine roots of molars to burst into the palate. Abscesses on the lower teeth also sometimes pierce the inner alveolar plate, and burst into the cavum oris. From the lower teeth pus may pass

downwards through the bone, or between the bone and its periosteum, and point under the chin or among the fasciæ of the neck, whence it may reach the thorax, and may in its course cause the diseases known as angina Ludovichi and œdema of the glottis.

From a molar tooth the pus may extend along the jaw into the pterygoid region, the temporo-mandibular articulation, or masseter muscle, and from these may reach the brain or ear.

Abscesses from the upper incisors, canines, and the palatine roots of molars, may burst into the floor of the nose, and from almost any of the teeth may reach the antrum of Highmore, or point on the cheek. Pus may also soak backwards, and form a retropharyngeal abscess.

Lastly, periodontitis may terminate in **necrosis** of the alveolus, the tooth, or even the body of the mandible or maxilla, when the infection is from a very virulent germ or a strong caustic, or the tissues having been weakened by previous injury (*e.g.*, phosphorus or mercury), or the patient's health is much reduced, as after the exanthematous or typhoid fevers.

Symptoms.

The local symptoms of periodontitis are **pain**, at first only slight, a mere uneasy tenderness, which is temporarily relieved by pressure; later, the tooth becomes too tender to bite, and mastication is performed on the other side of the mouth: finally, the pain becomes constant, heavy, and dull. It is clearly localized; drawing the finger along the sulcus, and pressing firmly over the roots of the teeth, will elicit a sharp wince when the inflamed tooth is reached. When organization is taking place, this tenderness remains, and the patient is liable to severe exacerbations of pain from heat, shaking the tooth,

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exertion, mastication, or any cause that may increase the blood-flow to the part; cold, as a rule, gives temporary relief. The extraction of the tooth at this stage is very apt to cause severe and prolonged after-pain in the socket. When suppuration occurs, the pain becomes throbbing in character and more severe. When the inflammation starts from the gum margin pain is often absent, and there may be very little tenderness except at the bottom of the pockets formed by the recession of the gum, at which part tenderness is very acute whilst the disease is progressing, and the exposed parts of the roots are often very sensitive to cold, sweet and salt substances, and to touch.

The increase in **heat** is not noticeable when the disease is confined to the **peridental** membrane only.

Swelling, when the inflammation starts at the apex of the root, is first shown by the projection of the tooth from its socket and its slightly increased mobility; then a ring of gum around the neck of the tooth becomes engorged, soft, **red**, and shiny, and detritus is very apt to collect between it and the tooth; also, the gum over the root in the labio-dental sulcus becomes thickened, velvety, and darker in colour, the 'health-line' disappears, and the outline of the roots cannot be felt by rubbing the finger along the sulcus. These symptoms will usually be present when organization is in progress, and a definite but sharply limited movement of the tooth can be effected with the fingers, which by no means promises an easy extraction. The alveolus may be thickened, and it is almost certain that the numerous, irregular, bony prominences found on the alveolar processes spoken of as **bony exostoses** are due to chronic osteoplastic periostitis, having its origin in the peridental membrane. Also, in the upper jaw a large **fibrous thickening** of the gum over the inner surface of the tuberosity is the frequent result of chronic

ymphangitis, having its origin in a septic condition of premolar and molar roots. Rarely, as the result of treatment of a dead root, a very rapidly formed, diffuse, soft, painless swelling of the gums occurs, and, if the gum is kept clean, as rapidly goes. When suppuration takes place, a very widespread **reflex hyperæmia** may quickly affect the gums and cheek, causing great swelling and redness; or there may be no noticeable increase until the pus has perforated the alveolar plate, when, together with a sudden decrease in the pain, a rapidly growing, rounded swelling may form near the apex of the tooth and bulge the reddened mucous membrane, so as to obliterate the alveo-dental sulcus, and soon after a diffuse redness of the cheek follows.

On the bursting of the abscess the swelling rapidly subsides. When a sinus exists, the swelling is more limited. In some old-standing cases the swelling may occur some distance from the originating tooth, and not involve it at all.

When the inflammation commences at the gum margin there is swelling and redness of the **gum**, at first soft and compressible, but as time goes on becoming firm and solid. It may form little **tags** of gum, projecting up between the teeth, and easily drawn away from them, or form a **hard raised margin**, or project into carious cavities as a pedunculated mass, called a **polypus** of the gum (see p. 98). The **alveolar** margin may be thickened or '**lipped**.' As the process spreads or becomes more severe the periosteum is destroyed, the alveolus **absorbed** from the inner side and eventually destroyed, and the gum recedes.

The tooth becomes **functionless**, because the patient is afraid to bite on it, and sometimes it is too loose to do any work.

The lymphatic glands in the submaxillary region, are enlarged and tender.

The general symptoms may be inappreciable, or the pain and sleeplessness may greatly reduce the patient, and when suppuration occurs there may be actual fever, preceded by a rigor.

From the long-continued suppuration of pyorrhœa and chronic abscess many general diseases may arise (see p. 127).

Diagnosis.

Inflammation of the periodontal membrane must be diagnosed from inflammation of the tooth pulp. The dull, constant, localized character of the pain, the tenderness of the tooth to pressure on the crown and over the root, and the swelling and redness of the gum around the neck, are the principal signs distinguishing it from the latter condition. It is, of course, possible to have both conditions present in the same tooth, and when there are several teeth presenting signs of pulpitis and periodontitis it is necessary to diagnose from which the pain proceeds. Sharp stabs of pain, lasting from a few seconds to an hour, are probably from a pulp, though needle-point absorption and exostosis may closely simulate it. A painful periodontitis will certainly cause tenderness to pressure, and probably to heat. Of the two, a pulpitis is far more likely to give pain than a periodontitis. The patients' diagnosis must **not** be relied on, as they often attribute a pulp pain to the most damaged tooth, for no other reason than that it is damaged.

It is also necessary to diagnose the extent and severity of the periodontitis, the colour and appearance of the swelling, the amount of recession of the gum, the looseness and tenderness of the tooth to pressure, the softness

or hardness of the swelling, the depth of the pockets around the teeth, the amount of pus that can be squeezed out; the heat of the parts, the character of the pain, and history of the case, must all be considered, and the number of teeth affected must be ascertained.

Lastly, the cause of the condition and age and health of the patient should be investigated before a safe prognosis and treatment can be given.

Prognosis.

Having examined the case thoroughly by inspection, palpation, and inquiry as to the history, the dentist ought to try to form an opinion as to the probable course the disease will run. The amount of damage done and the duration of the disease will be a large factor. An old gumboil or pyorrhœa is very hard to cure, but may run a long and almost painless course. Exostosis and absorption are permanent injuries, which may be checked, but never cured. The age and health of a patient have a great influence, tissues in youth recovering more readily than in old or middle age. Also the cleanliness of the mouth and the patient's willingness to help the operator are very important. The actual and predisposing causes of the trouble must be considered, as some are and some are not curable. It is very important also to remember the risks the patient is exposed to by the maintenance of a septic condition about the mouth.

Treatment.

Preventive treatment is the first to be considered, and has already been dealt with in the chapter on the hygiene of the mouth; but special stress may here be laid on the necessity of properly shaping and perfectly finishing fillings and crowns, so as to prevent the accumulation of

food and the irritation of the gums between the teeth ; of keeping the teeth free from tartar and of treating gingivitis early ; of making plates and clasps fit well, and of at once treating all sources of infection, such as septic roots and carious cavities. Regulation and separation of the teeth should not be done too rapidly or irregularly. Arsenic and other irritant drugs must be carefully applied and safely guarded. Weak teeth must not be roughly handled or exposed to abnormal pressure, and in root-canal cleansing great care must be taken not to push matter through the apical foramen or side of the root. The necks of teeth should be carefully cleansed before applying ligatures or clamps. Exposure to lead, phosphorus, or mercury should be avoided, or, if unavoidable, the mouth should be rendered healthy previously.

Curative treatment may be divided into local and general for convenience of description.

Local treatment consists in the removal of the cause of irritation, relief of congestion, and of drainage when pus is present, proper cleansing of the mouth, and provision of rest for the part.

When the disease is in the **earlier stage** of inflammation, or undergoing **organization**, removal of the irritant, cleansing of the mouth, relieving of undue pressure, and the application of counter-irritants, such as moderate heat, liquor iodii fortis, or capsicum plasters, will be the best measures, and will probably cure a commencing periodontitis, but are of far less efficacy for absorption or exostosis, because in them the removal of the cause is so much more difficult, and the circulation in the parts has been so altered. In fact, when such conditions cause much pain extraction of the teeth is advisable.

Alveolar abscess may sometimes be prevented by the timely treatment of the preceding periodontitis. When

recently formed a cure may be effected by carefully supporting the tooth with wedges of artificial dentine and cotton-wool to prevent the pain caused by handling it, opening up and cleaning the cavity, enlarging the entrance to the pulp cavity, and cleansing that also, then with small wisps of wool absorbing all the discharge from the root. If this can be done at one sitting it is best to disinfect and at once fill the root; if there still remains an exudation, an absorbent antiseptic dressing should be inserted and sealed in for a day, and repeated until the discharge ceases, when the root may be filled. If the root canals cannot be cleansed thoroughly, absorbent antiseptic dressings may be applied to the pulp cavity, and frequently renewed; but the prospect of success is far less, and root-filling should be postponed till the tooth has become firm, comfortable, and free from odour. If the abscess is an old one, the chance of complete cure by ordinary means is slight; but careful treatment often results in the temporary cure of the abscess and the formation of a painless, or only occasionally tender, sinus, the tooth being quite useful at most times.

The only way to ensure a complete cure of an established abscess is to cleanse the mouth and extract the tooth. The tooth may sometimes be saved if you cleanse and fill the root canals, and then make an incision through the gum over the apex of the root, turn back the gum-flaps, trephine or gouge away the alveolus till the abscess cavity is reached, evacuate the pus and any debris, smooth the root if rough, and daily pack with iodoform gauze until the space is filled up with healthy granulation tissue.

Short of such radical cure much may be done to improve matters. If a sinus exist and is open, cleansing the root canal and injecting liquor hydrogenii peroxidi through it

into the abscess and out at the sinus, and immediately filling the roots, may produce a complete cure, or leave a comfortable tooth and a painless sinus. Or the root may be cleansed and filled, and the abscess opened externally into the sulcus, drained, and encouraged to heal by granulations. When the root cannot be cleansed, all the débris that can be got away should be removed, and absorbent antiseptic dressings used, changing them as often as they become saturated with discharge. By using volatile penetrating antiseptics such treatment may in time temporarily or permanently cure the abscess.

In neglected cases, where the abscess has spread or burst outside the mouth, the dentist should make a very full examination of the oral conditions, and at once refer the patient to a surgeon, to whom the dentist should submit full particulars as to the conditions he has found, and an offer to assist in any operation that may be necessary.

An abscess that is threatening to burst on the face should at once have the dental cause removed, and efficient drainage provided via the mouth. If this can be done, then the external surface should be carefully cleansed, disinfected, and covered with an antiseptic, non-irritant dressing until the risk of an external scar is over. If not, the skin should be cleansed as before, and the abscess at once opened externally by a suitable incision, and a large absorbent antiseptic dressing and proper drainage provided.

It is useless and cruel to lance the gum over an alveolar abscess that has not yet penetrated the alveolar plate, unless the bone be also trephined; and in such cases it is usually better to induce the abscess to point on the gum by the local application of warmth, which is also comforting.

Whilst using such treatment, the mouth generally

should be cleansed, especial care being directed to cleansing and making smooth the exterior of the teeth and the gum surrounding the area of acute inflammation; a cleansing antiseptic mouth-wash should be prescribed, the bite on the tender teeth relieved, and a dressing of liquor iodi fortis applied.

Pyorrhœa alveolaris is a very difficult disease to cure. In order to succeed, all sources of irritation must be removed from the pockets formed about the teeth, fresh irritants must be prevented from entering, good drainage must be provided to remove any discharge: often a general toxæmia has to be cured, and an improved circulation be induced in a badly damaged and scarred tissue, in order to form a lasting cicatrix. The mouth must be made clean and **cleanable**. The difficulty is increased from the fact that the disease is usually, almost painless, while treatment is painful and long. The patient has acquired bad habits of insufficiently using or cleansing the teeth; the penalty of loss of the teeth is remote, and the general toxæmia attributable to other causes.

The **whole mouth** should be carefully **cleansed**, and the patient fully instructed how to keep it clean, and impressed with the absolute importance of continued thoroughness in this respect. All **carious cavities** must be filled, rough edges of fillings smoothed, ill-fitting pivots, **crowns**, or bridges removed, all septic **roots** and hopelessly loose teeth extracted, all **tartar** taken away, and the teeth made quite smooth. It is unwise to wound the gums until the septic condition has been much improved, and as the treatment will require numerous visits, it is best to do as much as possible without cutting vascular parts at first, and to prescribe an astringent antiseptic **mouth-wash** for regular use during the treatment. As the cleansing proceeds, the inflammation, swelling, and

tenderness will decrease, and render thorough operations more easy.

The disease is to some extent **contagious**, and not only must all instruments, brushes and powders, etc., be carefully guarded against conveying infection, but the patient also should be warned not to kiss or be kissed by any other person or pet animal. The procuring of adequate **drainage** is very difficult; **massage** of the gums, rubbing from the apex of the root towards the neck, each time the mouth is cleansed will much assist drainage and improve the circulation; deep pockets must be efficiently opened out; astringent lotions and great cleanliness will, by reducing the swelling, help to secure drainage, but sometimes it is necessary to cut away a considerable depth of gum before efficient drainage is secured; this should be done with iridectomy scissors and as neatly as possible, as bruising and ragged edges cause swelling and blockage. Loose teeth may require a temporary splint, and to have the bite eased from them. When the pockets are clean they should be well and often flushed out with hot normal saline solution, or a mild soluble antiseptic may be packed in and left.

The patient's **general health** should be attended to by a physician when there is any failure of the normal bodily functions—**anæmia**, **rheumatism**, **gout**, **syphilis**, **diabetes**, etc., being beyond the scope of the dental surgeon. But it must not be forgotten that a general **toxæmia** may be the result of inflammation of the mouth, and over and above the fullest local treatment it may be possible for a short time to improve the patient's power of resistance to the toxins by the preparation of an **antitoxin** from the germs found in the mouth, and injecting this into the patient.

Necrosis should be treated by the cleansing of the

part, thorough and frequent washing of any dead but unloosened sequestrum, and the provision of ample drainage. As soon as the sequestrum is loose it should be removed, and also all useless teeth and roots.

It now remains to describe those cases of periodontitis that are due to some **specific** cause, and therefore run a more definite course.

Periodontitis due to the escape of **arsenic** from a dressing may occur. Great care should be taken to remove all carious dentine from the edges, especially the cervical edge, of the cavity; loose flaps of gum (the commonest cause of difficulty) should be either packed back by a preliminary dressing of mastic and wool left in for a day or two, or with a pledget of gutta-percha wedged between the two teeth, or the gum may be cut away or destroyed with caustic. While the arsenic is being placed in the cavity, care must be exercised to prevent any from sticking to the gum, and also when inserting the protective dressing be careful not to displace the arsenic. The dressing, when not used to press back an excess of gum, or obtain separation of the teeth, should be smoothly finished off and no overlap allowed, so that free drainage between the teeth is possible in case of an escape. Arsenic must not be left too long in a tooth, as it will penetrate a thick layer of dentine. A second application of arsenic, when the first has failed to completely destroy the pulp, should be made, but the cavity should be thoroughly prepared first and a wide and fresh exposure of the pulp secured; it must be remembered that arsenic may penetrate outwards to the periosteum. The cavity should be filled with a neat and smooth-surfaced dressing and the gum margin be free of all irritation or obstruction to good drainage. When arsenic has escaped on to the gum, if the latter is freely exposed to the flow of the

saliva, little damage is likely to happen; but if it is held in contact by the dressing it causes an acute, deep, sloughing inflammation. The gum becomes tender, red, then yellow, and finally black and much swollen. The bone may be necrosed. Should the arsenic have penetrated through the dentine, or some pathological vascular canal or enlarged apical foramen, it will cause a most acute sensitiveness of the tooth to vibration, with or without other signs of periodontitis, according to the amount of arsenic escaped and the degree of sepsis complicating the trouble. When penetrating through the dentine slowly it may cause complete destruction of the periodontal membrane, and loss of the tooth, with very little pain.

Curative treatment consists in gently removing all dead tissue, well rinsing the part with hot water, cleansing and neatly filling the cavity in the tooth, prescribing an antiseptic mouth-wash, and instructing the patient to keep the space between the teeth quite open and free from food.

If necrosis of the bone has occurred, as soon as the dead portion is loose it should be removed. In cases of penetration through abnormal canals between the pulp and the periosteum, very gently cleanse the root and fill it with a mild antiseptic dressing and a temporary filling, and wait (usually a few weeks) till the tooth is quite comfortable before filling permanently.

Actinomyces occasionally occurs, the germs gaining entrance through a wound, pyorrhea pocket, or exposed pulp. The usual, slow-growing, indurated, painless swelling occurs, distending the bone, and eventually bursting on the surface and forming sinuses. The diagnosis may be made from the slow course, characteristic sinuses, and the discovery of the germs in the discharge. Treatment consists in the administration of potassium iodide and scraping out the sinuses.

There are several other special forms of periodontitis which usually end in **necrosis** of the jaws, such as in syphilis, the periodontitis following the exanthematous fevers and exposure to phosphorus and mercury, acute necrosis, and *cancerum oris*. These are described in the chapter on necrosis of the jaw (see p. 112).

EXTRACTION OF THE TEETH.

The operation of extracting teeth is such a technical matter that it will not be described here, but many matters appertaining to it can be profitably discussed in this book.

It is of great importance that the student shall have an exact **anatomical** knowledge of the shape, structure, relations, and **common abnormalities** of the teeth, gums, and alveoli.

He should also know when to extract and when to save a tooth, what results will probably follow the operation, and what complications may arise.

The principal cause for patients requiring to have **teeth removed** is on account of the **pain** they give. If the pain proceeds from the pulp only, it is always curable, and is not a sufficient reason in itself for extraction; but if it comes from the periodontal membrane it is not so readily cured, and in cases of dental exostosis, needle-point absorption, advanced pyorrhœa, fracture or perforation of the root, and rapidly spreading inflammation, if remedial treatment is not quickly successful, extraction is indicated.

A **septic** condition of the root, though not so often complained of by the patient, is a more common indication for extraction. All septic and useless teeth or roots ought to be removed at once, but roots or teeth that are

able to be made useful by treatment ought to be cleansed and saved. Teeth which, though still septic, are usually painless and useful, must each be judged individually, and the danger to health from possible infection or ptomaine-poisoning weighed against their utility to the patient and the probable effects of their extraction.

Crowding and irregularity of the teeth is often a just cause for extracting teeth, both to cure the crowding and prevent the increased liability to caries.

When **artificial teeth** have to be fitted, it may be wise to remove teeth that would otherwise be left, on account of the ugly appearance they would cause, the effect they might have in displacing other teeth or wounding the opposed gum, or the difficulty of fitting a plate around them.

On the other hand, it may be very important to **retain the natural teeth**, which bite far more efficiently than artificial ones.

The loss of one tooth may very considerably reduce the **masticating power**.

The **articulation** may be much altered. The bite may be then allowed to close, or, in order to get proper mastication, a new habit of mastication may have to be learned. An opposing tooth or teeth may be rendered useless, and degenerative changes set up in them. An abnormal and troublesome movement, previously prevented by the tooth, may be now made possible.

A **support** to a denture may be lost.

The **appearance** may be altered by the loss of a conspicuous tooth, or by the consequent alteration of the contour of the face, from the loss of support to the cheek and lips, or from the closing of the bite.

Speech may be affected.

The loss of a tooth may have a good or bad effect on

its neighbours. The removal of a carious tooth will prevent infection of its neighbour, or even permit of a superficial caries becoming naturally arrested. The removal of a tooth loose from pyorrhœa may allow the neighbours to be cured. The loss of a very tender tooth will allow the neighbours to be brought into full use again.

On the other hand, it may deprive the neighbours of useful support, may render mastication on that side so ineffectual that all the biting is done elsewhere, may cause a tilting of the teeth so that a good articulation is lost, and perhaps a 'food-trap' formed.

The **antagonists** may be little affected, or rendered functionless, or pressure may be applied only to one side of them and cause tilting.

The loss of diseased teeth will have a very beneficial effect on the **mouth generally**, by cleaning it and allowing painless mastication; it may cure irregularity of the teeth, or it may cause it; it may allow the jaws to close together unduly, altering the bite and appearance.

Early loss of the **second temporary molars** will permit the permanent molars to move forward, and so lessen the room for the anterior teeth.

When it has been decided that it is desirable to remove a tooth or teeth, a very careful **examination** of the patient, mouth, and tooth should be made before doing the operation.

The patient's **general health** may present features that render the shock of sudden pain inadvisable. There are many such conditions—such as, for instance, advanced cardiac disease, the later stages of pregnancy, especially in persons with a tendency to abort; also any condition that may give rise to excessive bleeding, from hæmophilia to menstrual disturbance. Should any such conditions be reported to the dental surgeon, it is his duty to obtain the

assistance of the practitioner of general medicine available. The conditions counter-indicating an anæsthetic may be left to the anæsthetist. In the case of nitrous oxide they are so few and so doubtful that they may be almost regarded as non-existent, provided the stomach be fairly empty and the thyroid gland be not abnormally developed.

If the mouth is very unclean, it should be as far as possible cleansed before operating.

The tooth itself should be carefully examined, the outline of roots ascertained, and it may be useful to cut away or pack back the overlying gum.

A very difficult and dangerous extraction may sometimes be rendered easy and safe by careful treatment beforehand, when such is possible. At times it is wise to postpone operating till conditions have become more feasible.

The administration of an anæsthetic may greatly assist the operator by ensuring the quietude of the patient, relaxation of muscle, and preventing the operator's sympathy for his patient interfering with his deliberateness and thoroughness of procedure; or it may hinder by causing jactation and venous congestion of the patient, and by hurrying the operator.

The operation itself will not be described here.

After the tooth is out, and the socket has been gently closed by pressing any displaced tissues back with the fingers, the wound should heal by filling with blood, which coagulates, becomes infiltrated with cells, fibroblasts, and capillaries from the surrounding parts, and is thus converted into granulation tissue, over which a layer of epithelium soon spreads. Any redundancy of bone is gradually removed by absorption.

Should this clot not form in the socket, as when the socket has been packed, or the clot becomes septic and

disintegrated, the healing is much delayed, and has to take place by the gradual filling up of the socket with granulations from the bottom.

1. The **time** necessary for the parts to assume a permanent form varies very much. Young, healthy subjects with an active circulation of healthy blood through the parts, a normal or rarefied condition of the bone, small-rooted teeth, and gentle massage of the gum, tend to a rapid settlement; whilst old and anæmic people, sclerosed bone, large-rooted teeth, teeth which have stood alone for some time, a septic condition and bruising of the parts, tend to prolong the shrinkage.

Many **complications** may arise during and after an extraction. From an error in diagnosis, or from obscuration of the field of operation by blood, or the rough use of a gag or prop, the **wrong tooth** may be removed. As soon as the error is discovered the tooth should be replaced, and steadied if necessary by a splint (see p. 54). Whilst attempting to remove a tooth a neighbouring tooth may be **displaced**, as a result of interlocking of the crowns or roots or of ankylosis; in such a case the operator should at once steady the endangered tooth with his left hand, and then either proceed more cautiously with the operation or stop, as circumstances may direct. A tooth or root may be pushed upward into the antrum, nose, or an abscess cavity, from whence it should be at once removed, enlarging the opening if necessary. Occasionally the sudden loosening of a tooth may cause the forceps to jerk up and **fracture** or displace another tooth, or when removing a temporary molar the crown of the permanent premolar may also come away. This accident is most likely to happen when the roots of the temporary molar are complete, and there is extensive periodontitis. Replacement of the tooth-germ is unlikely to

be successful. **Fracture** of the tooth to be removed is a common accident; should it occur, the remaining portion or portions should be removed with suitable instruments if possible. A small aseptic portion of tooth left in a healthy socket will become absorbed in time, but the larger the fragment and the more inflamed the parts, the less likely this is to happen, and then a sinus forms leading to the piece of root, which remains in a septic condition until caries and suppuration remove it. Should a live pulp be exposed by the fracture, and the root not be able to be removed, the sensitive surface should be destroyed by pure carbolic acid or nitrate of silver or removed under cocaine or a general anaesthesia. The causes of fracture of teeth during extraction and the details of treatment cannot be entered into in such a small work.

Teeth may be unusually **difficult** to move, either from the thickening of the alveolus that is apt to occur around healthy teeth exposed to unusual stress, from an unusual denseness of tissues of the patient, from impaction with other teeth, from thickening or abnormal direction, shape, size, or number of the roots, or from the operator having obtained a poor hold with the forceps.

The lower jaw may be **dislocated** during extraction of lower teeth if it is not properly steadied by the left hand of the operator, or the dislocation may be due to the violent use of a Mason gag, or even in some cases the improper use of a prop. The jaw should be at once replaced.

Fracture of the alveolus, partial or complete, and of a small or very large portion, sometimes happens, and is a common cause of after-pain and hemorrhage. The pieces, if not badly injured and aseptic and still adherent to the gum, should be replaced. Fracture of the body of the jaw is very rare.

The **lips** may be bruised by the handle of the forceps or elevator, or the **tongue** or **gums** torn by careless inclusion in the grasp of the beaks, or an instrument may slip and cut any of the adjacent parts.

Pain may continue or even increase **after** an extraction, and this is most marked in cases of exostosis of the teeth, when the surrounding bone is, of course, also inflamed, and often more injured than usual from the severity of the operation, and in rheumatic and anæmic patients. Great bending or bruising of the alveolar plates causes after-pain, and gum stretched over a thin projecting edge of alveolus long remains sore. Foreign bodies in the socket and septic infection cause pain.

Treatment consists in thoroughly cleansing the mouth and wound and replacing bent pieces of alveolus, and maintaining an aseptic condition with the frequent use of antiseptic washes, used hot where the heat does not bring on a paroxysm of pain.

Such tender wounds are slow to heal and try the sufferer's patience, but the use of caustic, though it may give a temporary relief, delays the permanent cure.

The **hæmorrhage** following an extraction should be treated on the ordinary lines; if slight, it should be left to heal by itself, or Nature may be assisted by the application of cold water. Any displaced tissues should be restored by firmly closing up the socket with the fingers.

The usual cause of excessive hæmorrhage after tooth extraction is the damage done to the gum and socket margins by a rough operation. An adherent piece of gum may be torn, leaving a long lacerated wound and a loose flap that the tongue can pull on and so disturb healing. An alveolar plate may be fractured and bent out, or there may be much bruising and crushing of the alveolar margin, and even gum also. If the tissues were much inflamed

or weakened by injection of a local anæsthetic beforehand, healing is still further hindered.

• Treatment should be first directed to the cleansing of the mouth before operation, and the avoidance of local anæsthetics in cases where there is periodontitis, next to the careful avoidance of unnecessary bruising or tearing of the tissues. When the tissues have been injured, displaced fragments should be replaced and torn gum steadied by stitches. The exact place of obstinate bleeding should be found, and gentle pressure very neatly and steadily applied to it so as to effectually compress that part against a firm resistance with the least possible obstruction to the healing of the wound. Accuracy, gentleness, and quiet are most important.

Steady compression with the fingers for a full five minutes will cure most cases. A few stitches are very useful to steady torn gums. Packing should be a last resort, and then the operator must be very clear as to the exact place and direction in which he desires to make pressure or the packing may greatly increase the trouble, especially when the bleeding is, as is usual, from the gum or socket margin. • Before packing all clot must be removed and the wound well washed with hot water to check oozing and clearly locate the bleeding spot.

Patients suffering from hæmorrhage should be kept quiet, sitting propped up in a chair, and no stimulants of any sort given; in severe cases it may be wise for the medical attendant to give sedatives, and even an infusion of saline solution.

Every effort is to be directed to assisting the bleeding orifice to close without interfering with other blood-vessels.

Reactionary hæmorrhage is to be treated the same as primary.

Secondary hæmorrhage, usually due to sepsis, is to be treated by thoroughly cleansing the wound, finding the actual bleeding spot, and treating as before.

Many **septic** complications may follow the extraction of teeth, caused most often by the dirty condition of the mouth before the operation, but sometimes by unclean hands or instruments or by foreign bodies getting into the wound. The prevention of such conditions has been already dealt with. The cure consists in thoroughly cleansing the mouth and wound, removing all dead matter, providing free drainage and frequent irrigation. If gauze plugs have to be used, they should be changed often.

Sloughing of the gum, necrosis of the jaw, and cancrum oris may all occur, or the germs of tetanus, spreading traumatic gangrene, syphilis, or actinomyces, may be inoculated, and produce their respective diseases.

Accidents may arise from the **anæsthetic** used. Sloughing of the gum and septic inflammation may be caused by injecting fluids, or the action of extreme cold, or the use of caustics.

The circulation or respiration may be arrested by a general or local anæsthetic. Inflammation of the bronchi may be set up by inhalation of very volatile vapours.

During unconsciousness foreign bodies may enter the air-passages or be swallowed.

Accidental injury may be caused by the unskilful use of the gag or prop or forceps to neighbouring parts, or whilst struggling the patient may bruise himself.

The after-effects of the anæsthetic may produce sickness, headache, or nervous prostration.

Patients after recovery from a general anæsthetic sometimes have hallucinations as to what was being done during their unconsciousness.

During pregnancy premature birth may be caused by the shock of pain in women predisposed to such accidents ; or during menstruation great nervous upset may occur, and profuse hæmorrhage from the wound has been recorded at such times. Extraction of a tooth may cause a fit of hysterics at any time.

The **shock** from the operation, though usually slight, may be severe, and call for treatment by warmth to the body, the recumbent position, and sufficient stimulants to maintain the pulse.

An epileptic fit may be brought on, when care should be taken to prevent the patient injuring himself or others.

SALIVA AND SALIVARY CALCULUS.

Saliva is the mixed secretion from the parotid, sub-lingual, and submaxillary salivary glands and the buccal mucous glands, and also contains 'salivary corpuscles' or leucocytes from the tonsils and other adenoid tissues about the mouth. Desquamated epithelium, micro-organisms, and food débris are also usually found in it. It is alkaline in reaction, but may become acid from the fermentation of its organic constituents. The parotid contains more carbonate of lime, and the sublingual and submaxillary more phosphate of lime. The salts of saliva are held in solution partly by the carbonic acid it contains, and when the carbonic acid evaporates the salts are precipitated on, and may adhere to, any surface that is not exposed to friction or constant exfoliation, and particularly on rough surfaces.

The saliva varies greatly in different individuals and at different times, and probably has a great deal to do with the growth of bacteria, but very little is known of this subject. Saliva is apparently not antiseptic, though the

leucocytes it contains may destroy a few germs. It produces a positive chemiotaxis in wounds.

It is very essential for the natural cleansing of the mouth, and may by its salts form a very important protection to the teeth against decalcifying agents.

Salivary calculi may form around small foreign bodies within the ducts of the glands, where, if large enough, they may be felt as hard, movable lumps. They give rise to obstruction to the flow of saliva and pain in and distension of the glands, particularly at meal-times. Inflammation is very liable to follow, and cause destruction of the gland substance or the formation of a fistula.

Tartar, which when slowly deposited is hard and black, and when quickly deposited is soft and yellow, consists of salts from the saliva and various organic materials, such as food debris, epithelial cells, germs, and their products. It is thought by some that tartar is sometimes deposited from the blood-serum on to the roots of teeth still completely covered by the gum, but this is a point very difficult to prove.

Tartar is first **deposited** in places where there is little friction from the tongue, mastication, or the tooth-brush, and particularly on rough or sticky surfaces. It then gradually increases by additions to its surface. It cannot adhere to the gum, from which the surface cells are constantly being shed, but by preventing the escape of septic products, it causes ulceration and recession of that tissue.

To **prevent** the formation of tartar proper mastication, regular arrangement, and cleanness of the surfaces of the teeth are most important.

When tartar has collected it should be carefully and completely removed, the teeth polished, and any predisposing cause to its redeposit, such as a tender gum or

tooth, rough fillings, defective articulation, gelatinous plaques, or irregular interdental space, attended to.

Many people who profess to clean their teeth regularly really never properly clean them, nor are even able to effectually rinse their mouths free from loose debris, seeming to use their tongue and lips to prevent free access of the water to the surfaces of the teeth, instead of as an adjuvant to the cleansing. To such people this defect must be pointed out, and very careful attention must be paid to make sure that there is no tenderness of the gums or necks of the teeth, which may be the cause of the habit.

Green and orange stains are produced on the teeth from the action of chromogenic bacteria, and sometimes are accompanied by destruction of the enamel below. They should be removed, and the parts carefully polished and disinfected.

INJURIES AND DISEASES OF THE MUCOUS MEMBRANE OF THE MOUTH.

Hypertrophy of the gums and alveolus has been reported as occurring in several children of a family, the children being mentally deficient. The hypertrophy affected the whole of the alveoli, and was of firm consistency, normal in colour, and free from tenderness. Treatment consists in cutting away the redundant tissue.

Polypi of the gum, little tags of gum between the teeth, and the thickening seen on the lingual aspect of the tubercles of the upper jaws, though resembling hypertrophy very closely, are inflammatory products.

Epulides are tumours growing on the gum, and the name is fast being replaced by more definite terms. Thus

the fibrous epulis is now called a fibroma of the gum, and the myeloid epulis is recognized to be a fungating portion of a myeloma (or myeloid sarcoma) of the jaw (see p. 111). Other tumours may also grow on the gum, such as papillomata, nævi, cysts, and epithelioma.

A fibrous epulis or **fibroma** grows from the periosteum of the alveoli, and is by some thought to be caused by local irritation. It has the same colour as normal gum, is pedunculated, and of any size up to a walnut. It is not hotter than normal, nor tender, and is of the same consistency as the gum. It grows slowly, displacing the neighbouring teeth, and is free from tenderness. When large, it may be bitten on and become inflamed, when it will swell more rapidly, become painful and covered by granulations. Microscopically they consist of fibrous tissue, with a thick covering of epithelium and enlarged papillæ.

Treatment consists in passing a ligature lightly round the base to define it, then, under an anæsthetic such as nitrous oxide, making an incision down to the bone on each side of the pedicle, forcing a narrow chisel from the one cut just through the surface of the bone and out at the other cut, and removing the growth. The neighbouring teeth should be left, unless they are diseased and useless.

Myeloid epulis will be described on p. 111.

Papillomata of various forms occur on the gum. They consist of little tufts of elongated papillæ, each having a central part of mesoblastic tissue, with a very much thickened epithelial covering. They do not cause any trouble, grow slowly, and are easily removed.

Small pedunculated papillomata sometimes grow and hang down from the junction of the hard and soft palate. They are spoken of by surgeons as 'epithelial pearls,'

which must not be confused with the enamel nodules on molars called by dentists by the same name. They are easily removed if the patient desires it.

Nævi.—Every form of nævus may be found in the mouth. The capillary and venous nævi are always an extension from a similar growth on the face. They very readily swell and bleed when injured, or if the teeth are not kept very clean. Unless increasing in size or causing trouble, they are best left alone, or they may be cured by electrolysis. If inflamed, the teeth should be very carefully cleansed, and astringents used to reduce the swelling. Arterial nævi, cirroid aneurisms, or aneurisms by anastomosis, as the growth is variously called, sometimes occurs on the palate, and forms a rapidly growing pulsating swelling, very difficult to distinguish from a rapid-growing sarcoma of the jaw. If cut, very severe hæmorrhage follows, so that the best treatment is an excision of the whole part.

Mucous cysts, from distension of mucous glands, may be found on any part of the mouth or lips. They form small, rounded, tense, elastic, movable, painless swellings, which are easily enucleated. Any large, thin-walled, bluish, semitranslucent cyst found in the floor of the mouth is called a **ranula**, and may have its origin from a distended mucous cyst, dilated portion of Wharton's duct or of the ducts of Rivini (though both these are rare), a distension of Fleischman's bursa, or dilatation of Blandin-Nuhn's gland. They are to be treated by removing a part of the wall with scissors, and either dissecting out the rest of the cyst wall or destroying it.

A sudden blockage of Wharton's duct may lead to a rapid swelling of that tube, known as an **acute ranula**. This is painful, especially after meals, and calls for a removal of the obstruction.

Odontomes may cause swellings on the gum or about the jaws (see p. 33).

A **dermoid cyst** is sometimes produced by distension of an unobliterated part of the thyroglossal duct, but will show in the neck, and not in the mouth.

Hydatid cysts may be formed anywhere.

Both **epithelioma** and **sarcoma** may occur in the mouth, and are to be recognized by the induration of the tissues at the base and spreading edges of the growth and early involvement of the submaxillary glands. Immediate removal by a surgeon gives the only chance of success.

Gingivitis, or inflammation confined to the gums, is very common ; it sometimes extends to the rest of the mucous membrane, when it is called stomatitis, or may spread downwards around the tooth as a periodontitis.

Gingivitis may be caused by direct injury, as from the rough edges of tartar, carious cavities, or fillings ; ill-fitting plates, clasps, crowns, or regulating apparatus ; the forcing of food, tooth-brush bristles, or other foreign bodies between the teeth ; the escape of arsenic ; excretion of mercury ; or from the fermentation of food in the interdental spaces ; the growth of germs at the gum margin, and the retention of their products.

General ill-health, irregularity of the teeth, tenderness of the teeth, and neglect of proper mastication and cleansing, will greatly predispose to this disease.

There is very little pain, as a rule, and often only very slight tenderness ; but the gums are red, often covered by a white growth of mycelium or the debris of food ; the teeth are dirty, discoloured, and often show early stages of caries of the enamel. The gums may be receded from pressure of impacted food or from ulceration, but the edges are soft and swollen, often standing up as small red

tags of gum between the teeth, or in old-standing cases form polypi of the gum. They bleed readily when brushed.

Treatment is very necessary before this condition has become chronic and caused cervical caries or ulcerative periodontitis.

Prevention is most important. Thorough mastication of food of a fibrous nature, proper morning and evening brushing, the correction of irregularities of arrangement of the teeth, the immediate treatment of all interstitial or cervical carious cavities with properly finished fillings, and the correct contouring of fillings, are essential.

When gingivitis exists, the first thing to do is to carefully and gently cleanse the necks of the teeth, remove all irritants, such as food, tartar, and rough edges, neatly fill all carious cavities, and adjust the fit of any plates or ill-fitting crowns.

The raw surface may then be swabbed and rinsed with some mild astringent antiseptic, and the patient directed to use a soft brush for a few days, and very carefully cleanse the gums. A little massage with the finger-tips dipped in an antiseptic lotion will help recovery. The dentist should himself cleanse and disinfect the gums at intervals of a few days until the tenderness and tendency to bleed has passed, and the patient will again masticate freely and cleanse the mouth properly.

When due to the escape of arsenic, it is important to remove any dead tissue, well syringe with warm water, and neatly fill the carious cavity, leaving free drainage from the wound, and not using any caustics; such cases may be slow to heal, on account of extensive destruction of gum and alveolus.

Stomatitis, or inflammation of the mouth, has been described under several divisions, such as catarrhal, ulcera-

tive, and gangrenous, according to its severity, and one kind may develop into another.

Catarrhal Stomatitis is an inflammation of the mucous and submucous membrane of the mouth, accompanied by a discharge of mucus.

It may be caused by mechanical irritation, as in teething; from chemicals, such as strong acids or alkalies; the abuse of spices, excessive smoking, or the excretion of mercury. It may be due to contamination from septic discharges retained under an artificial plate or around dirty teeth, or from a septic inflammation of the nasopharynx, or to infection, as after typhoid fever or during syphilis.

The **anatomical changes** consist of dilatation of the vessels of the submucous tissues, great exudation, and free proliferation of cells, especially the epithelial cells. The mucous glands are swollen and active. All the cells are sodden and weakened by the excessive exudation.

Symptoms.—There is seldom any pain, but much tenderness; the part is hot and more red than normal, very much swollen, soft, and there is a copious flow of mucus and saliva, which may undergo fermentation and smell offensively. Mastication is rendered difficult from the tenderness, and the submaxillary lymphatic glands are swollen, red, and tender. The general health may or may not be affected.

Treatment consists in maintaining the mouth in a clean state and avoiding strong irritants. When the disease is established the mouth should first be gently and thoroughly cleansed, all sources of irritation removed, cold bland fluid diet given, and a mouth-wash of chlorate of potash used three or four times a day. As soon as the acute stage is passed, all tartar and septic roots ought to be

removed, carious cavities filled, plates well polished, and, if recovery is slow, astringents should be used.

Ulcerative Stomatitis is an acute inflammation of the mouth, going on to the formation of ulcers about the teeth.

A catarrhal inflammation, if the mouth be very septic may become ulcerative, especially when due to mercury or teething. The disease is more common in children, and after the exanthematous fevers, than in adults, and may be caused by infection from impure milk and general unhygienic surroundings.

The infection almost always takes place at the necks of the teeth, causing an acute gingivitis, and as the germs multiply and spread they are inoculated into the neighbouring parts, and so the inflammation spreads, and from being only a hyperæmia goes on to thrombosis of the vessels, molecular disintegration or ulceration of the gum, and eventually of the periosteum and alveoli also. The more acute the case, the larger will be the sloughs and the deeper the necrosis. At the same time the absorption of the products of putrefaction will cause pyrexia, sapræmia, and even eventually death.

At first the gums are only congested and purple, with here and there more acutely inflamed follicles; the teeth are loose and tender, the pain is very slight, and the saliva is rather increased. Later, or in a more severe case, distinct ulcers are formed, and, on looking into the mouth, only a mass of epithelium and coagulated lymph may be seen; a very fætid odour is noticeable; there is a copious flow of saliva, and the mouth is too tender to allow of mastication. The submaxillary lymphatic glands are swollen and tender. On washing away this débris the ulcer is seen to extend around the necks of several teeth; its edges are ragged, serpiginous, and sharp; the floor is

covered with a yellow slough; the base is inflamed, and may consist of necrosing bone; the surrounding tissues are red, tender, swollen, and with here and there a suppurating follicle; the pain is slight at first, but soon becomes severe; the discharge is copious and foul.

Treatment consists in cleaning the mouth, washing it with a 2 per cent. solution of iodine, prescribing a chlorate of potash mouth-wash, and attending to the patient's general health and surroundings.

The term **Follicular Stomatitis** has been applied to the condition where a few scattered follicles of the gum become inflamed and ulcerated, forming very tender and painful sharp-edged ulcers, with yellow centres and a ring of red gum around; they are usually seen in the alveolo-labial sulcus. They can at once be cured by washing them and touching them with solid silver nitrate.

Aphthous Stomatitis is an inflammation of the mouth, accompanied by thickening of the epithelium at places, to form white patches.

The actual cause is not clearly known. It occurs in children, especially after severe illness and during teething, and sometimes in adults of lowered vitality.

There is an inflammation of the mouth and thickening of the epithelium, which, being sodden by exudation, becomes whitish, and patches of this may peel off, leaving little erosions.

There is pain and tenderness, heat, redness around the white patches, which are too adherent to be removed without pain and bleeding, and much swelling and salivation.

Treatment consists in cleansing the mouth, the use of a chlorate of potash mouth-wash, cauterizing with silver nitrate any obstinate spot, and attention to the general health and digestion.

Thrush, or parasitic stomatitis, is an inflammation of the mouth due to the growth of the *Oidium albicans*.

It attacks the very young and also very infirm, and in weak subjects is of very grave significance. The yeast grows in the superficial epithelial cell, and forms patches of mycelium, which can be readily and painlessly removed; the mucous membrane is much inflamed.

There is some pain, much tenderness, heat, and redness, with white patches of mycelium and epithelium on the surface. The mouth is dry, and mastication is difficult.

In healthy children the disease quickly yields to thorough frequent cleansing with glycerine and borax, but others sink and die of exhaustion, in spite of treatment.

Gangrenous Stomatitis is due to a parasitic bacillus. It attacks children in a weak state of health. The germ grows in the tissues, and causes a severe inflammation, which rapidly spreads and leads to gangrene of all the tissues it meets; at the same time such powerful ptomaines are absorbed that the child rapidly sinks and dies.

The disease usually starts as a small red spot on the inside of the cheek, soon penetrating to the skin and widening; next the central tissues necrose and form a black slough; the tissues around are very swollen. As the disease spreads large sloughs form and drop out, bones are exposed and necrose, and extensive damage is done.

The child is at first restless from the pain and fever, but soon loses strength, becomes apathetic, semi-conscious, and dies of sepræmia.

Treatment, to be of any use, must be prompt and thorough. The child must be placed in healthy surroundings, fed with clean milk and given stimulants. The dead tissues must be scraped away and strong caustics applied to the inflamed surfaces, and again repeated if spreading does not cease. Plastic operations will have to be under-

taken later to relieve the deformity caused by the destruction and scarring.

Mercurial Stomatitis is due to the irritation caused by mercury whilst being excreted by the oral mucous membrane, and is never troublesome in clean mouths; but when the mouth is septic and tartar has formed on the teeth, it leads to very severe inflammation, catarrhal, ulcerative, or even gangrenous, according to the severity of the septic complication. Hence all persons about to be treated with mercurials ought first to have their mouths made clean and healthy. When the disease has arisen, stop the administration of mercury, give purgatives and potassium iodide, and cleanse the mouth.

Syphilitic Stomatitis. --Primary chancres may occur in any part of the mouth from contact with infected pipes, drinking-vessels, instruments, etc., and will present the characteristic indurated base, and shotty glands. Early in the secondary stage a stomatitis is very common, together with the usual 'sore throat.' 'Snail-trail ulcers' and mucous tubercles form on the palate, cheeks, and tonsils, and are all virulently infective. Later on gummata may form on cheek, gum, or tongue, or burst through from the nose, forming a perforation of the palate.

Scurvy is a general disease due to imperfect feeding, and manifesting itself particularly in the mouth. It is due to the absence or destruction of certain chemical substances in the diet, and to the pasteurization or sterilization of all the milk given to infants.

There is a marked degree of anæmia and swelling and inflammation of the gums.

The treatment consists in the administration of fresh food, especially fruit and lemon-juice, together with cleansing of the mouth.

Purpura is more a symptom than a disease. Hæmorrhages from and into the gums occur in several forms of general disorders.

INJURIES AND DISEASES OF THE JAWS.

Dislocation will be treated of on p. 121.

Cleft-palate is a congenital defect caused by imperfect union of the embryonic folds which go to form the palate. It is sometimes hereditary, especially from the mother.

The slightest **degree** is a bifid uvula, and requires no treatment. Next comes division of the uvula and soft palate, then division of soft and hard palate as far as the anterior palatine foramen. These deformities are due to non-union of the two palatine processes of the first or mandibular arch. Next in severity is a division of soft and hard palate as far as the anterior palatine foramen, the division then turning to one or other side, and passing through the intermaxillary bone between the central and lateral incisors, passing, in fact, between the internal and external processus globulares of the naso-frontal process, and often being associated with a hare-lip. Lastly, there may be an ordinary cleft as far as the anterior palatine foramen, and then a double cleft through both sides of the intermaxillary bone and a double hare-lip, in which cases the central portion is generally small and displaced, so giving the appearance of a wide single central cleft.

Children with cleft-palates are unable to suck properly, often have other defects, and are difficult to rear. They will be late in learning to talk, and never be able to speak clearly, whilst food is liable to escape into the nose when attempting to swallow.

The natural tendency of the palate muscles during the act of deglutition would be to widen the cleft, the *tensor*

and levator palati pulling up and outwards, the *palati glossus and pharyngei* pulling down and outwards; but as this action is detrimental to the patient, all these muscles atrophy, whilst the *superior constrictor* muscle, which tends to close the fissure during swallowing, hypertrophies, so that in actual practice the fissure is found to **narrow considerably when the patient swallows.** The posterior wall of the pharynx has very little movement, but what there is would be forward when swallowing. The tongue and larynx are, of course, raised upwards and backward as usual.

There are two methods of treatment - the operative and the mechanical.

In all children who are strong enough to bear an **operation**, who have healthy mouths, and sufficient tissues to reach across the gap, the operative treatment should be adopted. As to the time of operation, surgeons hold diverse views, some advising operating immediately after birth, while the gap is small, and to enable proper feeding and a natural growth of the parts; others advising to wait till after the period of teething, when the child is better able to bear the shock and obey instructions. In either case the result may be very good, or the voice may be but little improved. Partial failure of the operation is common, and supplementary operations may have to be done to close the holes left.

There are two principal methods of **mechanically** treating a cleft-palate which has not been operated on in childhood—one by means of a hard vulcanite plug, the Suerson plate, and the other by a soft velum, the Kingsley plate. The former has the advantage of cleanliness, permanency, simplicity of construction, and is very successful; the latter has been said to give a better articulation, but is seldom employed now.

To make a **Suerson obturator** an ordinary model is taken, and an ordinary metal trial-plate struck up, with which the bite can be ascertained, and any teeth and bands that may be required tried on. To the back of the trial-plate is fixed a metal tag, which may be bent to lie in the centre of the fissure and reach almost as far back as the posterior wall of the pharynx. Around this tag is moulded a lump of soft impression composition; the plate is then put in the mouth, and the patient instructed to swallow. The superior constrictor, as previously indicated, will squeeze the soft material into the shape of the fissure during swallowing—that is, when at its smallest dimension, the surplus material escaping upwards towards the nose and into the pharynx below. Remove the plate, and trim away the excess above and below, and repeat the operation two or three times with the patient sitting with the head erect or even a little forward. Finally, trim the front surface to form a natural concavity towards the tongue, the edges not projecting in front of the remains of the soft palate. Cut off any excess below the level of the uvula, and reduce the height from above, so as to have about $\frac{1}{2}$ inch depth from above downwards, to afford sufficiently broad sides for the remains of the soft palate to rest against during deglutition.

The plate and its prolongation should now completely close the fissure between the mouth and nose when the patient swallows (narrows the cleft), but should show a space on either side, and even at the back, when the muscles are at rest.

The plate and its prolongation are then invested in a flask, and reproduced in hard vulcanite, making any thick parts hollow for the sake of lightness. The posterior edge of the plate often has to be eased to prevent undue pressure on the posterior wall of the pharynx.

Perforations of the palate may be due to direct violence, alveolar abscess, tertiary syphilitic or tubercular necrosis of the palate. In the first case the parts should be replaced as well as possible and sutured, when they may heal well. In the other cases the cause of the disease must be treated, and the parts cleansed and allowed to heal, if possible; any small holes may then be closed by a plastic operation. If the hole that remains is too large to be thus closed, an ordinary plate bridging over, but not pressing on the edges of, the hole should be made.

A **facial cleft** is due to a lack of union between the palate process of the mandibular arch and the naso-frontal process; it is more rare than hare-lip, and lies external to the alae of the nose.

Mandibular clefts are very rare, though sometimes a depression may be found in the centre of the lower lip.

A **mental fissure** is due to non-union between the dentary and mento-Mechelian centres of ossification of the lower jaw above the mental foramen, thus converting it into a deep open gutter. This will cause a space between the premolar teeth.

The lower jaw may fail to develop on one or both sides, and may retain its **infantile shape** as well as size. A slight deficiency in growth of the lower jaw is very common, causing a receding chin. This defect has been variously ascribed to insufficient use during infancy, the small size of the tongue, to mouth-breathing, and to some illness during the period of most active growth.

The lower jaw may grow too long, causing an **under-hung** jaw and square, prominent chin.

One side of the jaw at the condyle may develop more than the other late in life, causing great deformity and difficulty of mastication.

Bony swellings, known as exostoses or osteomata, are

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not rare on the jaws, but probably further knowledge will lead to the subdivision of these tumours according to their causes, which are not understood now. On the inner side of the lower jaw, opposite the mental foramen, and in the centre of the roof of the mouth, are common sites for very slow-growing, painless, bony tumours. No treatment is called for except the easing of artificial plates to avoid pressure on them. The tuberosities of the upper jaw are sometimes enlarged. Sometimes numerous, irregular, bony nodules form on the outer alveolar plate opposite the roots of the teeth, and remain even after the teeth have been lost. There is reason to believe that they are inflammatory in origin. They are painless, and do not need treatment.

A slow-growing cyst from between the alveolar plates will, in its early stages, produce a single, rounded, painless, bony swelling, but as it increases in size the bone becomes thin, and can be bent so as to give a crackling sensation under the finger, and still later distinct fluctuation can be felt. The early stage of such a cyst can be diagnosed from an osteoma by being single, regular, and rounded, and by the absence of a tooth (dentigerous cyst) or presence of a decayed root (dental cyst).

A **myeloma** may form within the interior of the jaw, usually the mandible, in young subjects, especially boys, starting from the bone-marrow. It is composed of round or spindle cells, fibrous tissue, and myeloid or giant cells, and by its growth causes an enlargement of the bone; finally it bursts through the gum and forms a fungating, purplish, rapid-growing myeloid epulis. These tumours are not now regarded as malignant, but require rather extensive operation for their total removal, as they start within the jaw.

Leontiasis is a rare disease in which there are diffuse

osseous growths of the face or cranium, which are symmetrical and apt to press on nerves and block up cavities such as the antrum and orbit, and cause great deformity. Chiselling away the growths is the only treatment that can be adopted.

Acromegaly is a rare disease, consisting in an overgrowth of the long bones, and also of the upper and lower jaws. No treatment is of any avail.

Sarcomata and **epitheliomata** may arise within the jaw from tooth-germs, and by their growth and extension cause death.

All **inflammations** of the periodontal membrane, either from infection from the apex of the root or the gum margin, are accompanied by osteitis of the alveoli, and the usual changes of rarefying osteitis, sclerosing osteitis, osteoplastic periostitis, and necrosis may all be found.

Necrosis of the jaws only will be dealt with here, the other conditions having been described under the pathology of inflammation of the periodontal membrane. The pathology and symptoms of inflammation of bone must be carefully learned from a work on general surgery, and only special facts relating to the jaw-bones will be mentioned here.

Direct injury, except in the case of arsenic (see p. 84), seldom causes necrosis unless the wound is septic. Small pieces of alveolus may necrose after a difficult extraction, when the tissues have been much bruised, a local anæsthetic injected, or great cold applied. Several teeth and their alveoli may be broken away from the body of the jaw, or the tuberosity of the maxilla may be loosened, and if the parts are not kept very clean may necrose.

In addition to the ordinary **symptoms** of inflammation of the gums and bone, the dead piece of bone may be visible after cleansing away the discharge as a greyish-

white rough surface surrounded by red granulations or black sloughs. On examining it with a probe it will be found to be rough and hard, but porous enough for a sharp steel point to penetrate into it (dentine is too hard to penetrate unless it is carious), and it may be firm or loose. It is not tender, and does not bleed.

Treatment consists in the avoidance of undue injury to the tissues, especially when they are weakened by previous inflammation or old age. When a sequestrum has formed, good drainage must be provided by making a free opening through the soft part, keeping this open by means of daily renewed strips of antiseptic gauze packing or hard vulcanite pegs attached to securely fitted plates, and frequently syringing out the cavity with a mild aseptic fluid. As soon as the sequestrum is loose it should be removed, carefully dividing any adherent soft tissue, and the cavity allowed to fill up with granulations from the bottom. Necrosed pieces of alveolus are not replaced by bone, nor are necrosed portions of the upper jaw, but the lower jaw is very readily repaired by new bone formation.

Mercury, when administered to a patient, is excreted to a certain extent by the mucous membrane of the mouth, and sets up irritation of these tissues. The resulting hyperæmia will cause any slight injury or septic infection (most commonly from tartar around the lower teeth) to produce far more damage than would ensue in normal conditions.

Before patients are given prolonged treatment with mercury the mouth ought to be thoroughly cleansed, and the patient instructed to keep it so. Should necrosis occur, the mercury should be stopped and ordinary local treatment given.

Phosphorus in the ordinary yellow form causes great

lowering of the vitality and fatty degeneration of any tissues exposed to it. Phosphorus fumes cannot enter the tissues except through an open wound or ulcerated surface, such as an exposed or dead pulp or pyorrhœa pocket, or after the extraction of teeth. When patients with such wounds are exposed to phosphorus fumes their general health is very much damaged, and the jaws so much injured that very widespread necrosis readily occurs from septic infection, and the toxæmia from the absorption of the discharge may result in death. In all cases in which it has been sought for, the tubercle bacillus has been found in the pus from the wound, and is thought by some to be a necessary factor in the disease.

In such cases the patient will be noticeably ill from the toxæmia; there will be a history of exposure to the fumes of phosphorus; the teeth and gums will probably be very unhealthy; there will be the usual local inflammatory symptoms, and the sequestrum is likely to be very large.

Phosphorus necrosis can be prevented by using the amorphous brown phosphorus instead of the yellow, and by keeping the mouth clean and free from caries, wounds, or ulceration of the gums.

Curative treatment consists in removing the patient from exposure to phosphorus, free drainage and frequent irrigation of the sinuses, and tonic general treatment. Sequestra should be removed as soon as possible. Bone is said to be peculiarly readily re-formed in the lower jaw.

During convalescence from the **exanthematous** or **typhoid fevers** a periodontitis, rapidly going on to necrosis of the alveolus, is liable to occur about septic teeth. Septic temporary teeth being so very common in children, necrosis is often widespread and bilateral.

The disease starts as a periodontitis with the ordinary

symptoms, but instead of healing spreads, and soon forms a huge ulcer around the teeth. There is not, as a rule, much pain, but the teeth are loose and tender, and the breath is foul.

Great care should be taken during such illnesses to keep the mouth and teeth clean and healthy. Any periodontitis should be promptly attended to. When necrosis has occurred, the ordinary local treatment should be given, and great care must be exercised, when removing sequestra and temporary teeth, not to damage the permanent tooth-germs, which may escape injury from the inflammation, though at times they are destroyed and exfoliated.

Acute necrosis, a disease more common in the long bones of children, sometimes attacks the lower jaw, and usually in the molar region.

The symptoms and prognosis are similar to those in cases occurring elsewhere, and death is not uncommon.

In cases of diffuse, rapid, spreading inflammation of the jaws of young patients, accompanied by rigors and high pyrexia, there should be no delay in making free incisions from the outside, as the extraction of a tooth is quite ineffectual, and drainage from an incision within the mouth is very seldom sufficient. If the disease is allowed to spread into the neck or thorax, death is almost certain.

Cancrum oris has been dealt with on p. 105.

Occasionally a diffuse, spreading traumatic gangrene starts from a wound in the mouth and invades the neighbouring tissues of adults, due to a very virulent infection or to greatly lowered vitality of the tissues or general health. The wound looks red and swollen at first, then the redness and swelling spread, leaving the central part dead, black, and often evil-smelling. The lymphatic glands are

enlarged and tender, and the patient has severe fever, soon becoming asthenic in type. A very similar wound is sometimes seen after a local injection of eucaïne or other anæsthetic into a septic gum, the whole infiltrated area becoming an ill-smelling grey slough; but it does not spread, and under careful treatment heals.

In cases of spreading traumatic gangrene the wound must be scraped and cauterized to destroy the infection, and the patient's general health attended to. Such diseases as **diabetes** and **albuminuria** may be present, and are of grave significance.

Tubercular inflammation of the jaw is not common; at least, the infection has not often been proved. In some cases tubercular disease of the nose has caused necrosis of part of the roof of the mouth and a perforation. The disease may be diagnosed by the apple-jelly-like granulations, the presence of tubercle bacilli in the discharge, and usually by several other manifestations of tubercular disease in other parts of the body.

Treatment must be directed towards improving the general health, the removal of all tuberculous tissue, and the fitting of an obturator.

Tertiary syphilitic gummata may form in the mucous membrane of the nose at the junction of the septum and floor or in the alveolar process, and when they become septic extensive necrosis follows, which, if untreated, will continue to spread slowly, especially when irritated by the presence of foreign bodies inserted to close the hole.

Treatment should be directed towards the general disease by the administration of potassium iodide, and locally cleanliness and good drainage are important. Small holes may sometimes be closed by a plastic operation after the disease has ceased to spread, but large holes must be treated by artificial plates.

Actinomycosis of the jaws is caused by direct infection through some open wound, and produces a slow-growing, painless, indurated swelling, which later on bursts and discharges its contents, leaving a depressed scar. This happens many times, the disease still spreading.

The streptothrix may be found in the discharge if very carefully sought for, but it is not always easy to find. This disease should be suspected in cases of chronic discharges from the jaw. The internal administration of potassium iodide is very beneficial, but if a sinus has formed all the diseased tissues will have to be scraped away as well.

In all cases of necrosis of the jaw it is very necessary to look for the cause, and when this is not obvious search should be made for uncrupted teeth, odontomes, and malignant disease. In the last case the diagnosis of the cause is most important.

Fracture of the Jaws.

Fracture of the jaw may be caused by direct violence or by indirect violence, as when a blow on the chin causes a fracture of the neck of the condyle.

Fractures of the horizontal ramus are always compound fractures, because the gum is so closely adherent that it is bound to be torn. Fractures of the ascending rami are usually simple.

Fractures may be incomplete, as the bent alveolar plates, or complete; single or double; vertical, horizontal, or oblique; sometimes comminuted; and may be complicated by hæmorrhage, necrosis, or surgical emphysema, from the involvement of some of the air-sinuses of the face.

The common sites of fracture are the alveolar plates; the body of the jaw in the region of the lower canine, and

behind the last molar ; separation of the alveolar process from the base of the jaw ; a horizontal fracture of the ascending ramus ; and across the neck of the condyle. •

The **signs** of fracture are severe pain ; a sharp, loud crack ; loss of power of mastication ; deformity, due to the displacement of the parts and the hæmorrhage and inflammation ; and crepitus.

The **displacement** will depend on the direction of the force, the line of the fracture, and the action of the muscles. A few typical examples may be given. In fracture through the lower canine region the smaller fragment is generally inside and below the larger. In fracture through both canine regions, the middle fragment is drawn down, in, and tilted backwards by the genio-hyoid and digastric muscles, and the lateral fragments are drawn inwards by the mylo-hyoid. Fractures of the horizontal rami are unaccompanied by displacement, owing to the tendinous insertions of the temporal and masseter muscles. In fracture of the neck of the condyle the small piece is drawn up and inwards by the external pterygoid, whilst the bulk of the jaw is pushed over to the injured side by the opposite external pterygoid.

Healing, as a rule, occurs readily in either jaw, though new bone is not formed in the upper jaw except to a slight extent in young and healthy people. Necrosis is more likely to occur in the lower jaw, from its greater density, lesser vascularity, and the greater difficulty of drainage, whilst surgical emphysema is more common in fractures of the upper jaw. Six weeks is the usual time in which to get firm union, but it may be delayed by necrosis of the ends of the bone, the slipping of a tooth between the fragments, imperfect fixation, or general ill-health.

Treatment consists in cleansing the mouth and keeping

it as aseptic as possible, replacing the parts and fixing them in position.

All septic roots and teeth should be removed, the remaining teeth cleansed and full instructions given to the patient or nurse as to the thorough frequent flushing of all parts with a mild antiseptic. Swabs of wool and a syringe are often necessary adjuncts to effective cleansing of obscure corners.

Four-tailed bandages and external gutta-percha splints are only temporary methods of keeping the parts at rest, and may even increase the displacement.

Wiring the teeth or the jaws together by means of thin wire interlaced between a few teeth, or heavy wire put through holes drilled in the bone, usually fails very quickly, from loosening of the teeth or necrosis of the bone.

The best methods are by means of the interdental splints. The Hammond wire splint is the best to use when there are firm teeth in each fragment, the Hayward or Kingsley vulcanite splint when one or both fragments are edentulous or only contain loose teeth, and Herli's modification of the Gunning vulcanite splint for multiple fractures when the two former are not efficient.

Metal cap splints are also very valuable at times; they give a good hold but open the bite. They should be cast to fit the crowns of the teeth well and fixed with copper cement.

To make a **Hammond splint**, cleanse the mouth, remove tartar, extract loose septic teeth and any tooth that is touched by the fracture. Take a model of each jaw with beeswax, make plaster casts, and break the lower cast at the same place as in the patient. Reset the broken cast, using the upper model as a guide to the correct position. Make a zinc model from the reset cast. Take a piece of soft iron or German silver wire about

2 mm. in diameter and fit it well to the buccal and lingual aspects at the necks of all the teeth and round the backs of the last molars; if any teeth are absent, bring the two bars together across the gap, and fix them with solder. Join the two ends of the wire by inserting them into a small silver tube and soldering them.

Place the splint in the patient's mouth, fit it to the larger fragment, loosely wire it into place; then, under an anæsthetic, force the smaller fragment into the splint, and wire firmly. The wiring is done with silver suture wire, passing it over the outer bar, between two teeth, and under the inner bar; pull through a few inches and pass it back over the inner bar, between the neighbouring teeth, and under the outer bar twist the ends firmly together; cut off the surplus, and tuck the sharp end under the outer bar. Wire two or three teeth in each fragment, avoiding the teeth nearest the fracture, as they are liable to become loose and tender.

The Hammond splint is efficient, small, clean, and almost invisible, and does not interfere with the movements of the jaws or drainage from any wounds.

To make a **Hayward** or **Kingsley** splint, take models and reset as before, make a vulcanite plate to cap the lower teeth, and in it insert two thick, stiff wires (old excavator handles will do well), so that the projecting part leaves the vulcanite opposite the canine teeth, turns upwards and outwards so as to pass out of the corner of the mouth without pulling down the lip, and then turns backwards horizontally across the outside of the cheek as far as the ascending ramus; roughen the wire outside the mouth. If a good impression has not been obtained, it is best to enlarge the holes for the teeth and line them with gutta-percha. Insert the plate as before, heated if gutta-percha has been used, and fit it to the large piece,

and then force the smaller piece into the splint, place a pad under the chin, and with a 1-inch bandage make figure-of-eight loops round the wires and under the chin, so that the jaw is held firmly between the splint above, with its wires and the pad, and bandages below.

This splint is large, unsightly, makes it difficult to keep the mouth clean and aseptic, and also prevents complete closure of the jaws.

Modifications of this splint are numerous, the bandages and external wires being replaced by adjustable clamps.

The original **Gunning** splint consisted of an upper and lower vulcanite plate capping the teeth, vulcanized together, but Mr. Hern has modified it by making a lower plate only with projection above the teeth, short at the back and longer in front. The tops of these projections are hollowed out and filled with warm gutta-percha, so that, when the plate is inserted with the fragments in place, the jaw can be closed till the upper teeth rest into the projections, when a bandage is carried several times over the head and under the chin, and fixed by a few horizontal turns round the head.

This splint fixes the jaws partially open, and is very uncomfortable.

Injuries and Diseases of the Temporo-Mandibular Joint.

The temporo-mandibular joint is not a close-fitting articulation in man, and is therefore rather liable to **dislocation** on one or both sides. In some people the ligaments are so lax that a partial dislocation or **subluxation** can be produced voluntarily. Yawning, sickness, or very hearty laughter may produce dislocation, but more commonly it is due to direct violence, such as a blow, extracting lower teeth without properly supporting,

the jaw, the violent use of a Mason gag, or too large and obliquely placed props during the administration of an anæsthetic.

The displacement is always forwards, and the jaw is protruded to the opposite side in unilateral dislocation, and is fixed open, so that it is very difficult for the patient to speak.

Treatment consists in at once replacing the bone, and instructing the patient not to open the mouth wide for some weeks. Reduction is usually very easy. Seat the patient in a low chair, place your thumbs, guarded by a napkin, on the lower molars, and the fingers under the chin; then press firmly downwards and backwards with the thumbs and tilt up the chin with the other fingers, when the jaw will go back with a snap.

The joint may be absent or undeveloped on one or both sides.

Synovitis may arise from exposure to cold, from strain, or from rheumatism or tubercle, and is treated by rest, warmth, and the treatment of any general disease. As soon as the acute symptoms have subsided, gentle massage and exercise are beneficial.

Arteritis may be due to pyæmia, gonorrhœa, tubercle, gout, or extension from inflammation about the teeth, or from middle-ear disease, the last being most common in children. It may lead to ankylosis of the jaw. Both diseases should be at once referred to a surgeon.

Osteo-arthritis is not very rare, and leads to an enlargement of the condyle, stiffness and clicking of the joint. It is, as a rule, a slow-spreading disease, and protection from cold and injury and gentle massage and exercise are all the treatment that is necessary. When very severe, excision of the condyle may be called for to prevent complete ankylosis.

Trismus, or closure of the jaw, may be due to many conditions.

Inflammation is the most common. The inflammation may be in the joint, and prevent movement by the pain, an attempt to open the mouth causes, or afterwards by producing a fibrous or even bony ankylosis by the formation of adhesions or destruction of the cartilage. Or the inflammation may be in the surrounding tissues; in the muscles the infiltration may cause a reflex spasm and stiffening of the tissues, or the movements of the jaw may press on tender tissues, as in mumps and tonsillitis, and so the patient may refuse to open the mouth. Erupting wisdom teeth, alveolar abscesses, and necrosis of the jaws, may cause sufficient infiltration and tenderness of the tissues to produce trismus. Again, extensive ulceration of the mucous membrane of the mouth, as from cancerum oris or syphilis, may produce such firm contracting scars in the cheek that the jaws may be bound close together.

Malignant growths may destroy the joint, and malignant or innocent growths in the parotid gland may mechanically obstruct any movement of the jaw. An exostosis of the zygoma has been said to obstruct movement.

- In dislocation the jaw is fixed open.

Strychnine poisoning causes severe contractions of the muscles, including the temporal and masseter, which are strong enough to firmly clench the jaws. Such contraction is only temporary or clonic, and there are periods of rest.

Tetanus causes a more constant or tonic contraction, and affects the jaw muscles early.

In **epilepsy** and some cases of hydrophobia, and during **anæsthesia**, there may be strong spasms of the muscles of mastication.

In each case it is necessary to diagnose the condition

present, and also the cause of the condition. The cause should be treated or removed, and the local conditions treated on general lines.

By the administration of an anæsthetic spasmodic contraction may be often relieved, but gentleness should be exercised in forcing the jaws open, so as not to rupture inflamed and infiltrated tissues, nor force pus into the tissues of the neck.

Young, fibrous adhesions may be broken down by passive extension and regular exercise; old, strong adhesions and bony ankylosis will require removal of the condyle, or even the formation of a false joint farther forward in the jaw. Cicatricial bands in the cheeks will require a plastic operation.

INJURIES AND DISEASES OF THE ANTRUM OF HIGHMORE.

Though the treatment of disease of the antrum is not a part of dental surgery, but belongs to the rhinologist or general surgeon, yet a dentist may be called upon to assist in the constriction of apparatus and treatment of teeth involved in or causing the disease, and should certainly have a good knowledge of the anatomy and pathological conditions of this cavity, so as to be able to make a diagnosis of such diseases as may be caused by dental disorders.

The antra are not formed at the time of birth, so that no congenital malformations are possible, but the size of the antra varies very greatly in different individuals and at different ages; moreover, they may be partially subdivided by septa, and may have direct communications with the ethmoidal and frontal sinuses.

§ **Innocent new growths**, such as papillomata, fibromata,

odontomata, osteomata, mucous, dental, and dentigerous cysts, may affect the antrum.

Cysts may push the mucous lining in front of them, and so come to fill the bony cavity without communicating with the air-sinus or the nose; they may even have a thin bony wall between. All such cysts were formerly called 'hydrops antri,' but are now described according to their cause of origin. A slow-growing cyst seldom causes any pain, but after filling the cavity it presses on the bony walls, causing absorption within and new formation of bone outside, the former process being the more rapid, so that the bony wall appears to 'expand,' becomes thin, and may be felt to give and crackle under pressure, and finally is totally absorbed, when fluctuation can be felt. Nasal obstruction may be caused on the affected side, and the translucency of the bone is altered. These cysts are very liable to septic infection, when they become inflamed, suppurate, and form abscesses—a condition formerly called 'empyema antri.'

Uninflamed cysts, when diagnosed, should be dissected out, the bony walls replaced as far as possible, and good drainage of the wound provided. Such operation is best done by a surgeon.

Solid tumours whilst aseptic are not likely to be detected unless very large, but when inflamed they usually cause considerable trouble and necrosis, and have to be removed.

Of malignant growths, **sarcoma** generally arises in the naso-pharynx and spreads to the antrum, whilst **epithelioma** may rise from the antral lining. They grow rapidly, affect the thick and thin walls equally easily, may cause the teeth to become irregular and loose, and soon project beyond the walls, producing the typical induration and fixation of the tissues, and enlargement of the

lymphatic glands. Pain is often severe before the growth is at all large, and is generally mistaken for neuralgia. Early removal of the whole bone and all affected tissues by a surgeon is the only chance for cure.

Inflammation may be acute or chronic. **Acute inflammation** is generally the result of direct injury, the entrance of a septic foreign body (such as a tooth), or extension of inflammation from the nasal cavities or from the teeth. The presence of a new growth may predispose to septic infection and acute inflammation.

The **symptoms** are heavy pain and tenderness to pressure; the cheek feels hot, and is red over the maxillary bone; there is swelling of the cheek, and sometimes obstruction of the nose. There will be a discharge of pus, and some slight pyrexia.

The risk of pushing roots of teeth into the antrum or breaking away part of its floor should always be remembered when operating on the upper premolars and molars, and undue violence avoided. Abscesses on upper teeth should be promptly treated, for fear of their bursting into this cavity, and all septic roots or teeth removed or cleaned and filled. If a root is pushed into the antrum, it should be removed as soon as possible, enlarging the hole if necessary, and either flushing it out with a warm, mild aseptic solution, or extracting it with wire loops or thin forceps. If an alveolar abscess has burst into the antrum, the tooth causing it should be extracted. When an opening has been made into the antrum from the mouth, by accident or design, if the lining of the cavity is uninjured except at the point of entry, the orifice should be closed as quickly as possible, and the mouth kept very clean. If the lining is inflamed, as soon as the cause of irritation is removed drainage should be provided by means of a gauze plug until the mucous membrane has

recovered. In cases of inflammation of the antrum caused by other than dental lesions or by odontomes, or cases in any way complicated, the patient should be referred to a general surgeon.

Chronic inflammation of the antrum causes far less definite though similar symptoms, and if suspected, a careful examination of the mouth and teeth should be made, and the patient be sent to a general surgeon, together with a report of the conditions observed.

It may frequently happen that the surgeon will require an opening to be maintained into the mouth, and for this purpose a small close-fitting plate should be made, to which is attached a gold tube just long enough to reach into the antrum. This tube should be provided with a close-fitting inner split tube closed at the lower end, which the patient may remove for flushing out the antrum, and replace to prevent food entering.

DISEASES ARISING FROM DISEASES OF THE TEETH AND GUMS. - -

If the teeth are too tender or too loose to permit of free mastication, or too few to efficiently perform it, then the food will be swallowed in lumps that are too large for the digestive juices to act on readily; moreover, the act of mastication is a valuable stimulant to the gastric secretion, and if omitted the food is passed down to the stomach before it is ready to receive it. The partial digestion of the starchy matter is also neglected. As a result the stomach and intestines have a much greater burden thrown on them, and will very soon be overtaxed. In old people, who eat less and rest more, and munch their food a long time before swallowing it, the loss of the teeth does not seem to matter very much.

Carious cavities in teeth, **septic hollow roots**, **irregular interdental spaces**, and **loosening of the gums from the teeth**, all provide very favourable spaces for **saprophytic germs** to grow and produce their toxins, which by irritating the tissues produce a **gingivitis** or even **stomatitis**, and the formation of a greater quantity of **germs and toxins**. These by the movements of the tongue, etc., will be spread to the pharynx, bronchi, and stomach, and may set up **inflammation** in these parts, sometimes slight or transitory, at other times severe or chronic.

Exposed or dead pulps, **ulceration** about the necks of teeth, **gumboils**, and the **wounds** left after the extraction of teeth, leave a more or less open way for the **entrance** of germs, **toxins**, and such irritants as **phosphorus** and **lead**. The formation of a healthy layer of granulation tissue will partially, and usually adequately, close such entrance, but often the granulations are imperfect.

Local inflammations, such as periodontitis, alveolar abscess, gingivitis, pyorrhœa alveolaris, and the wider inflammations to which these lead, considerably **weaken the tissues** involved and the **lymphatic glands** that drain them, so that germs which were formerly unable to get a hold now readily do so, and render the patient liable to such diseases as **tubercle**, **tetanus**, **diphtheria**, and to **necrosis** of the jaws and **cancrem oris** when they are still further weakened by fevers or malnutrition.

From **local inflammations** about the teeth toxins, and even parasitic germs also, may develop and enter the general system, either by being swallowed and absorbed, or by direct absorption by the lymphatics. From this may result acute or chronic **sapremia** or **pyæmia**, or any specific form of these diseases—*e.g.*, suppurative **endocarditis**, **meningitis**, **rheumatism**, and several forms of **blindness**. **Anæmia** also may be thus caused.

REMOTE DISEASES ARISING FROM TEETH 129

Some patients who have become acclimatized or are immune to the various toxins formed in and about the teeth whilst in good health, when they are attacked by any disease which lowers their vitality lose this immunity, and the resulting local inflammation, when added to their other illness, may seriously delay or even prevent recovery.

The pain caused by diseases of the teeth may be so severe and prolonged as to prevent sleep and also the possibility of doing mental work, and, even in a few days, may greatly lower the patient's health.

The pain, more especially from diseases of the pulp, but also from septic roots, malplaced teeth, and even from edentulous alveoli, may not be felt locally, but be referred to some other part of the body, and to a certain extent it is possible to foretell which areas the particular teeth will affect, or, to put the matter more practically, from the position of the pain to diagnose which is the tooth that is causing the trouble. Such referred pain is spoken of as **neuralgia**.

Not only will disease in a tooth cause pain to be felt in another part of the body, but it may produce other nervous symptoms, such as alterations of the **blood-supply**, **grey-ness** of the hair, and **impairment of function**.

All these symptoms are far more readily produced in patients with a weak and hypersensitive nervous system, or whose general health is feeble, and it must not be forgotten that many other conditions besides diseased teeth, such as malignant disease, inflammation of the air-sinuses, malaria, anæmia, and neuritis, may cause neuralgia in the same areas as those affected by dental neuralgia.

The general diseases caused by teething are dealt with on p. 14.

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